NAVAL FIGHTERS NUMBER TWENTY THREE

CONVAIR XF2Y-1 AND YF2Y-1

Sea Dart

BY B. J. LONG

INTRODUCTION

Many people refer to the pre-war era as the Golden Age of Naval Aviation. To me, the Golden Age of Naval Aviation has always been the post-war era. A time when everything imaginable could and was tried. Everything from tailless aircraft, to vertical take-off aircraft, to swing-wing aircraft, to composite aircraft, and to even supersonic waterbased interceptor fighter aircraft like the Convair SeaDart.

The SeaDart test program began in December 1952 and ended in late 1957 with the three test aircraft performing over 300 test operations. All tests were conducted from the Convair San Diego Bay seaplane ramp. Four Convair engineering test pilots were involved plus several Navy test pilots from the Naval Air Test Center, Patuxent River, Maryland.

Five SeaDart aircraft were built. Only three were flown, with four aircraft still in existence today. The second aircraft crashed on 4 November 1954 and the last two aircraft were completed as airframes only, without the engines ever being installed.

No. 1 - XF2Y-1 BuNo 137634
No. 2 - YF2Y-1 BuNo 135762
No. 3 - YF2Y-1 BuNo 135763
No. 4 - YF2Y-1 BuNo 135764
No. 5 - YF2Y-1 BuNo 135765

Naval Fighters is proud to present the SeaDart's story as told Billy Jack (B. J.) Long, Convairs project engineering test pilot for the XF2Y-1.

ABOUT THE AUTHOR

Billy Jack Long, also known as B. J., was born and raised in Johnson City, Tennessee, where he majored in industrial engineering at the University of Tennessee. Early aviation activities in the 1930s included airplane rides at the local cow pasture airports and the winning of several state contests for free flight gas model airplanes.

His first professional position in aviation was with Monocoupe Aeroplane and Engine Corporation of Bristol, Virginia, in 1941 as a draftsman, junior engineer, and stress analyst. He soloed in an early J3 Cub before entering the Naval Aviation Cadet Program during World War Two.

Commissioned in 1944, B. J. chose single-engine seaplanes for operational training and followed with duty flying catapult floatplanes from a cruiser in the Pacific. Within a few years, he had become qualified in a large variety of naval aircraft plus proficient as a control and chase pilot for large drone aircraft and target pilotless aircraft. Duty assignments included the Operational Development Force, Naval Missile Center, and Fleet Utility and Drone Squadrons.

B. J. retired as a Commander in the Naval Reserve with active service in World War Two and Korea.

From 1953 through 1957, Long was an engineering test pilot for Convair in San Diego, California. He was project engineering test pilot on the Navy's XF2Y-1 SeaDart, the World's only supersonic seaplane interceptor. He was also an engineering test pilot on the F-102A, at Edwards Air Force Base, California.

Long is a member of the Society of Experimental Test Pilots and a graduate of the U. S. Navy Test Pilot School. He accumulated more than 3,000 hours in over fifty different types of aircraft.

The SeaDart story by B. J. Long was presented in part at the Society of Experimental Test Pilots 1976 annual meeting and in various publications including the American Aviation Historical Society (spring 1979), Naval Aviation News (January 1981), Association of Naval Aviation (April 1989), Air Fan (October 1982), Air World (1984) and other books.

All photos without credits were provided to B. J. Long by General Dynamics. Special thanks are extended to the management and staff for their cooperation and support.

CONTRIBUTORS

JIM BURRIDGE, RON DOWNEY, GENE HOLMBERG, CLAY JANSSON, STAN JONES, CRAIG KASTON, BOB KOWALSKI, WILLIAM T. LARKINS, BOB LAWSON, WILLIAM SWISHER, TOMMY THOMASON, NICK WILLIAMS, AND CONVAIR.

SeaDart configuration graphics were created by noted aircraft artist, Stan Jones.

Anyone having photos or other information on this or any other naval or marine aircraft, may submit them for possible inclusion in future issues. Any material submitted will become the property of NAVAL FIGHTERS unless prior arrangement is made. Individuals are responsible for security clearance of any material before submission. ISBN 0-942612-23-X
Steve Ginter, 1754 Warfield Cir., Simi Valley, California, 93063

FRONT COVER

The number two aircraft, YF2Y-1 135762 idles out in preparation for a take-off run in the deep-blue waters of San Diego Bay.

BACK COVER

Aircraft number one, XF2Y-1 137634.

Top, early test run with original paint scheme and J-34 engines. More colorful yellow markings were added later as seen in the middle photo. Here the first SeaDart idles past the Convair seawall. Bottom, 137634 starts its final test run with the single small (second configuration) rigid ski in the fall of 1957. Don Germerrad was at the controls.

THE CONVAIR XF2Y-1 AND YF2Y-1
SEADART
EXPERIMENTAL SUPERSONIC SEAPLANE INTERCEPTORS
BY CDR B. J. LONG, USNR (RET) FORMER CONVAIR ENGINEERING TEST PILOT

Seaplanes played a major role in the world development of aircraft and their application to civil and military needs for more than four decades of aviation history. Because costly airfields and runways were not needed, the seaplane was instrumental in establishing transcontinental air travel and in opening up the Pacific to America through the famous Pan Am Clippers. In 1910, a Frenchman made the world's first seaplane flight and in 1911 the United States Navy took delivery of their first hydro-aeroplane to found Naval Aviation. Just three years later, the St. Petersburg-Tampa Airboat Line became the world's first scheduled airline. In 1916, the Curtis H-12 flying boat became the first American built aircraft ever used in aerial combat. During the 1930s the seaplane captured numerous world speed records. In September 1931 a British Supermarine S6B broke the 400 mph barrier. This was followed by a 440.6 mph record set by an Italian MC-72 in October 1934.

World War Two caused worldwide development of airfields and long distance aircraft which helped spell the demise of the seaplane, but not in the U.S. Navy. In the late 1940s, the Navy studied a naval "mobile base" concept using a family of seaplanes (F2Y SeaDart, R3Y Tradewind, and P6M SeaMaster) that would be supported by suitable naval vessels anchored or buoyed in sheltered water. The Navy contracted Convair to study the "mobile base" system and develop conceptual designs of water-based aircraft capable of performing such operations. The initial design for a twin-engined water-based jet fighter was known as the "Skate". The Skate employed a blended-wing design which was ultimately dropped when test data from NACA (National Advisory Committee for Aeronautics) on hydro-skis and test data from Convair's delta wing XF-92 became available.

Convair entered the Navy's competition for a water-based interceptor on 1 October 1948 with a new idea in mind, a hydro-ski delta wing interceptor named SeaDart. A development contract was issued on 19 January 1951 for two XF2Y-1 aircraft, which would be prototypes of a definitive water-based supersonic interceptor.

This action resulted in an experimental flight test program that began in December 1952 and continued through most of 1957, or for almost five years. A total of five aircraft, including one prototype, were built. The

E.D. "Sam" Shannon, Convair's Chief of Engineering Flight Test, taxis the XF2Y-1 137634 down the seaplane ramp to conduct the SeaDart's first test operation. Aircraft is over-all Navy blue with yellow tail and fuselage stripes.

first was the XF2Y-1, Bu. No. 137634 (137635 was never built). The remaining four were YF2Y-1s, Bu. Nos. 135762 through 135765. Of these five, only three were flown, since engines were never installed in the last two. Originally twelve F2Y-1s were ordered (Bu. Nos. 135762 through 135773) on 28 August 1952. The first four F2Y-1s were completed as YF2Y-1s with the remaining eight aircraft being cancelled.

During the early 1950s airframes frequently progressed faster than the engines being built to power them. Such was the case with the SeaDart program. The specified Westinghouse J46 engines were not available in time for the XF2Y-1 and the lower power J-34 engines were utilized. The YF2Y-1s had the J-46s but the Navy's problems with the engines led Convair to propose a F2Y-2 powered by a single Pratt & Whitney J-57 and utilizing a single central ski.

Shannon emerging from the cockpit after an early taxi test in the XF2Y-1

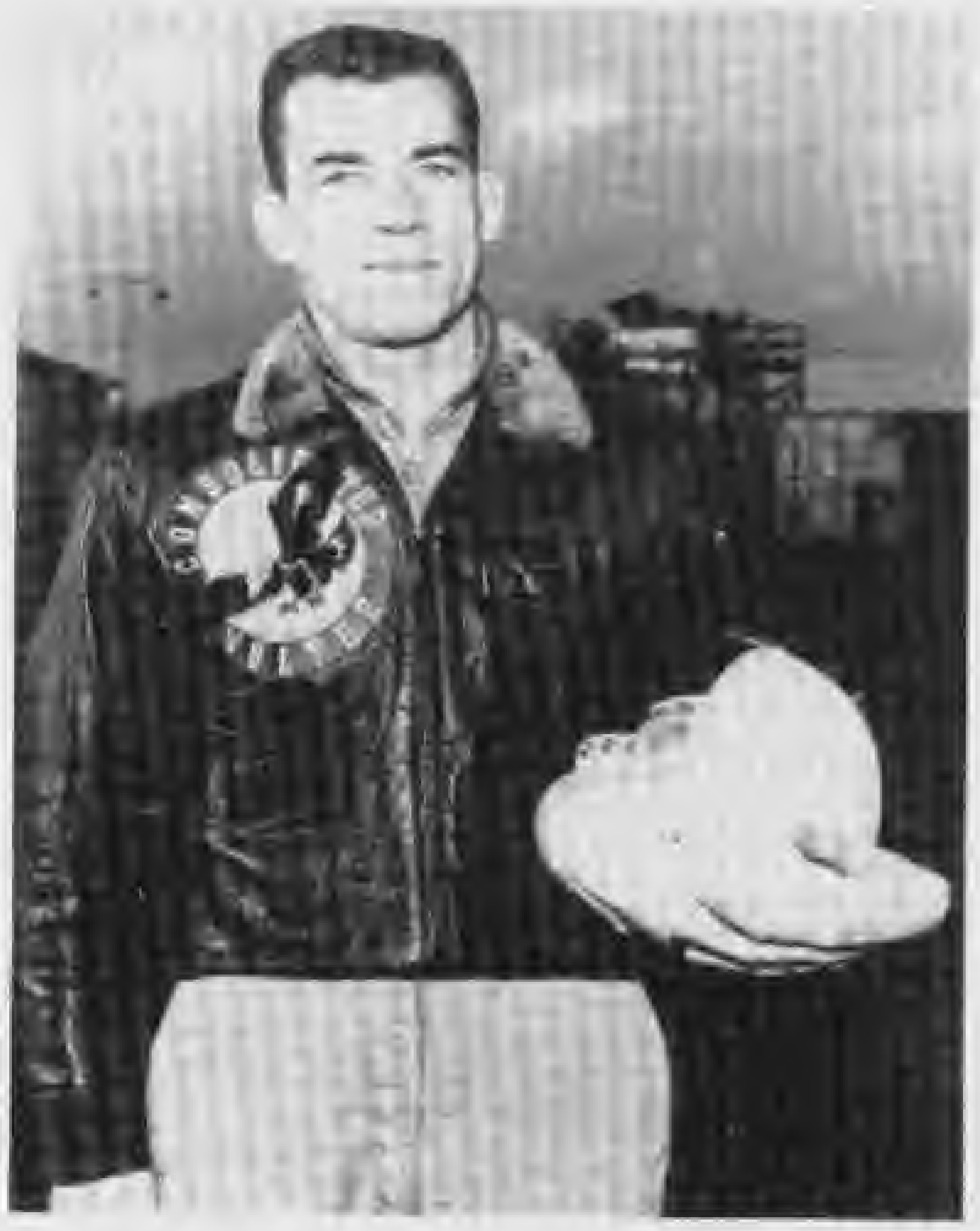
On 14 December 1952 Convair's Chief of Engineering Flight Test, E.D. "Sam" Shannon, took the XF2Y-1 SeaDart out into San Diego Bay for its first taxi tests. The aircraft was equipped with small wheels at the aft end of the skis, and a small tail wheel. This enabled the aircraft to taxi up the seaplane ramp under its own power during beaching operations. This same technique was used to enter the water.

The twin hydro-skis were actually planing skis and derived their lift in the same way as water skis. They were not hydrofoils, in the true sense of the word, which provide lift in the same manner as airfoils.

Early taxi tests in San Diego Bay revealed a serious vibration and pounding of the aircraft created by the blunt afterbody of the skis as they traversed wave patterns. The rougher the water, the more serious the vibration, which was amplified by the skis flexing between the front and main oleo struts. These excursions acted like a tuning fork and set up a resonant frequency in the aircraft structure. Since the forward struts of the skis were mounted directly below the cockpit, the combined vibration and pounding reaction loads created completely unacceptable conditions for the pilot and equipment during takeoff and landing. The immediate action was to solve the vibration problem without major design changes on the skis.

XF2Y-1 137634 on its first flight on 9 April 1953 with "Sam" Shannon at the controls. The nose probe broke off because of extreme vibration during taxi tests and was temporarily faired-over for the first flight. By this time in the test program very extensive yellow markings were added beyond the original tail markings.

On 9 April 1953, Shannon made the first flight of the XF2Y-1. The dark-blue paint with yellow markings provided aircraft attitude reference in instrumentation photos of taxi tests



Charles E. Richbourg, Convair's second Engineering Test Pilot assigned to the SeaDart program, was killed in the number two aircraft (YF2Y-1 135762) on 4 November 1954.

The author and third SeaDart Engineering Test Pilot sits in YF2Y-1 135763 prior to a test run.

including takeoff and landing.

Around this time, Charles E. Richbourg, another Convair Engineering Test Pilot, joined Shannon in the taxi tests of the XF2Y-1 twin-ski aircraft primarily as a test bed for twin-ski afterbody changes and modifications directed towards reducing vibration and pounding loads in the aircraft and specifically the cockpit. Such tests continued until middle of 1954.

In September 1953, I asked for release from active duty in the Navy to join Convair as a Flight Test Engineer on the SeaDart project. My duties included flight test operations planning, test conductor support, and flight test data analysis. In this position I became very familiar with all aspects of the SeaDart program and test operations.

SeaDart number two, YF2Y-1 135762, was rolled out in early 1954 with afterburning Westinghouse J-46 engines and twin-skis without wheels installed on the ski afterbodies. An auxilary beaching gear was required for ramp handling and water ingress and egress. Richbourg made the initial flights in the Number two aircraft and then began to explore high-speed performance plus the aerodynamic stability and control characteristics of the SeaDart.

Shannon and Richbourg began open sea tests several miles south of Point Loma with this aircraft as seen below. The open sea tests involved support and standby rescue boats and auxiliary craft. For safety reasons, at least one helicopter and one chase aircraft were required. These were also used for photo coverage of the tests. In addition, recovery tests were

Richbourg just after touchdown in YF2Y-1 135762.

conducted with a large Navy landing ship dock (LSD) to evaluate possible open sea support and service for SeaDart type aircraft.

In June 1954, I was assigned pilot duties in engineering flight test and began to train as back-up pilot for J.F. "Skeets" Coleman on the XFY-1 Pogo, Convair's cruciform tail-setter vertical takeoff and landing experimental aircraft. I began flying chase on Pogo, SeaDart, and R3Y Tradewind tests with a Navy AD-5 aircraft. I also flew copilot for Lou Hoffman on Convair 340 and 440 engineering test flights.

Richbourg continued flight and twin-ski tests on the number two aircraft and on 3 August 1954 exceeded Mach 1.0 in a shallow dive from 34,000 feet. Unfortunately, the SeaDarts were designed, built and flown before the supersonic "area rule" was embodied in aircraft design. Because high thrust engines were not available at this time and the airplane experienced high transonic drag, the anticipated maximum level flight speed was reduced from Mach 1.4 to Mach .99.

During the summer and fall of 1954, the XF2Y-1 had afterburning J-46 engines installed and was reconfigured with a large single hydroski that was not fully retractable. It was to become the hydrodynamic test vehicle for the single ski and to fully demonstrate its practical and suitable use as an operational configuration. There was no need or intention to use this aircraft again for high performance aerodynamic testing. Shannon and Richbourg began taxi tests with the new single ski in the late fall of 1954 and immediately encountered unacceptable hydrodynamic stability and control characteristics.

Engineering Test Pilot B.J. Long taxis the XF2Y-1, single ski configuration, down the Convair seaplane ramp for his first test in the SeaDart.

On 4 November 1954, Richbourg was killed during a flight demonstration for the press in the number two aircraft. During a low altitude pass, at about 500 knots, the aircraft went into a divergent longitudinal pitch oscillation and structurally broke up during the second nose down pitch. This accident was a classic example of the divergent pitch oscillation caused by combinations of high speed at low altiude (high dynamic pressure), early full power flight control system characteristics and pilot inducement or "PIO" (pilot induced oscillation). This accident had no bearing on the fact that the SeaDart was a seaplane or that it had any unusual design deficiencies. As a result of this accident, all SeaDart operations were temporarily suspended after the crash until the Navy accident

board had completed its investigation.

I volunteered to assist Shannon on the SeaDart program and was accepted primarily because of my World War Two seaplane experience. Shannon felt that prior seaplane experience was essential in order to satisfactorily conduct hydrodynamic demonstrations and evaluation that was required during the remainder of the program. Thus, my clearance to operate the SeaDart was requested from the Navy's Bureau of Aeronautics in Washington.

On 29 December 1954, Shannon was scheduled to resume taxi tests on the XF2Y-1 with the new single ski; however, a mild illness prevented him from making the test and I was cleared by Captain Slauson USN, senior Bu Aer rep at Convair, to make the test rather than delay the test program. I continued to test this single ski configuration for over two years with the last actual flight of the XF2Y-1 on 16 January 1956 during an open sea landing and take-off demonstration in a Seastate 5.

On 4 March 1955, I made the first Flight Test Operation (FTO-1) in the new YF2Y-1 (135763), or number three aircraft, performing taxi tests plus two take-offs and landings. This aircraft had the final twin-ski configuration with ski afterbodies that included a new wheel design installation deleting the need for an auxilary beaching gear.

Since all high performance aerodynamic testing of the SeaDart was canceled after the crash of the number two aircraft, the prime purpose of the number three aircraft was the final evaluation of the "optimized" twin-ski design changes and to demonstrate possible operational feasibility of the twin-ski configuration including open-sea operations.

Single ski tests with the XF2Y-1 aircraft continued simultaneously with the YF2Y-1 twin-ski number three aircraft. I conducted the final twin-ski test on 28 April 1955 in aircraft number three. With the XF2Y-1 large single-ski test program and the final twin-ski evaluation on the YF2Y-1 number three aircraft both completed, these two aircraft were placed in storage due to test program completion, the lack of an operational requirement for a waterbased fighter interceptor and lack of funds.

XF2Y-1 single-ski aircraft touches down at 120 knots.

The Navy's Bureau of Aeronautics in late 1956 directed the design and testing of a small rigidly-mounted single hydroski with hydro-foil shape on the XF2Y-1 aircraft. The rigid, almost parallel mounting and placement made actual takeoff impossible because of the seventeen degrees to nineteen degrees nose high attitude required for take-off. On 21 March 1957, I tested this new small rigid ski in San Diego Bay. Severe pounding

loads in the cockpit kept me from ever reaching more than 50 to 60 knots. Three test operations in eighteen days concluded tests on this configuration. This rigid ski configuration proved to be totally unacceptable.

In August 1957, I left Convair to pursue a non-flying career. At this time, the Navy's Bureau of Aeronautics directed the fabrication and testing of another single rigid ski design about half the size of the previous rigid ski, for installation on the XF2Y-1. In the fall of 1957, Donald P. Germeraad, Convair's Chief Engineering Test Pilot for Navy and Commercial aircraft, made taxi tests on this smaller rigid ski. His tests proved the same as mine on the previous rigid ski; unacceptable. With single-ski evaluations now considered completed, both number one and number three aircraft were placed in storage.

At this point, the three test aircraft in the SeaDart program had performed over 300 test operations, of which the XF2Y-1 or number one aircraft had accounted for 250 test operations. I had conducted over 100 of the test operations which included the XF2Y-1 single-ski configurations and the final twin-ski configuration on the YF2Y-1 (135763).

The test program was most intense and explored unknown areas in high speed hydrodynamics relative to water based aircraft. Much knowledge was gained about ski configurations tested, aircraft handling qualities, and pilot techniques for optimum performance and operation in varying water surface and wind conditions. The twin-ski design, even in its best and final configuration on the YF2Y-1, number three aircraft, was not acceptable for an operational aircraft because of intense vibrations and pounding loads on the aircraft and pilot. Hydrodynamic stability and control; however was excellent. It was the large single-ski design on the XF2Y-1 that showed the most promise of being suitable for a delta wing supersonic waterbased aircraft.

The following sections of this book provide greater insight into the role each of the three test aircraft played in evaluation of the design concept, performance, operating characteristics, and possible applications of these unique aircraft. Also reviewed are the Convair and Navy test pilots, engineering staff, ground crews, and others that contributed to the design and testing of the SeaDart.

Hopefully this book will help dispel any misinformation about the magnificently beautiful SeaDart.

The author, B.J. Long poses in front of the definitive SeaDart, YF2Y-1 135763. This aircraft maintained its overall Navy blue color scheme. Yellow camera tracking designs were never added. This aircraft had VHF antenna strakes added to the upper fin, one on each side.

SEADART NUMBER ONE, XF2Y-1 Bu No 137634 (TWIN - SKI)

The XF2Y-1 was assembled in the experimental shop of Convair's Lindbergh Field Facility. In late fall of 1952 the aircraft was transported at night with canvas coverings to a hangar at the Convair seaplane ramp area on San Diego Bay just west of the U. S. Coast Guard Facility. After thorough ground testing and operation of the twin non-afterburning Westinghouse J-34 turbojet engines, the XF2Y-1 was readied for water testing.

On 14 December 1952, E. D. "Sam" Shannon, Convair's Chief of Engineering Flight Test, took the XF2Y-1 SeaDart out into San Diego Bay for its first taxi tests. After completing the test, the aircraft taxied up the seaplane ramp under its own power. Small fixed wheels at the aft end of the skis plus a small swivel tail wheel provided this land taxi capability. The same technique was used to enter the water.

The initial and early taxi tests in San Diego Bay revealed serious vibration and pounding of the aircraft created by the blunt or boat-tail afterbody of the skis traversing wave patterns. The rougher the water the more serious the vibrations became. The vibrations were amplified by the skis flexing between the front and main oleo struts. These excursions acted like a tuning fork and set up a resonant frequency in the aircraft structure.

The front struts for the skis were mounted directly below the pilot. The combined vibration and pounding reaction loads on the front struts created completely unacceptable conditions for the pilot and equipment during takeoff and landing. The immediate engineering action was to solve the vibration problem without drastic and major ski design changes.

On 9 April 1953, Shannon made the first official flight of the XF2Y-1. The dark-blue paint with yellow markings provided aircraft attitude reference in instrumentation photos of taxi tests including takeoff and landing.

Charles E. Richbourg, Convair Engineering Test Pilot, soon had

"Sam" Shannon idles out for taxi tests on 12-14-52. The shape of the interim J-34 "Sugar Scoop" exhausts are evident. NAS North Island and a Navy sub tender made up the backdrop for this test.

joined Shannon in the taxi tests and the evaluation of the XF2Y-1 twin-ski aircraft. This aircraft continued to be used primarily as a testbed for twin-ski configuration changes directed towards reducing vibration and pounding loads in the aircraft and specifically the cockpit. Such tests on the XF2Y-1 with twin skis continued through 1953 to mid-1954.

It was quickly determined that changing the aft portion on the afterbodies of the twin-skis was the best and most expedient way of reducing vibration and pounding loads in the aircraft.

Convair had conducted extensive hydrodynamic testing of the original twin-ski afterboby design on scale model aircraft. The Navy had also done similar testing at the David Taylor model test basin near Washington, D.C. Convair also tested instrumented scale model skis attached by a boom to a highspeed motor boat. It was apparent that scale effects had not revealed the hydrodynamic and structural dynamic characteristics of the full size skis and resulting aircraft vibrations.

The twin-ski design was and appeared to be structurally rigid; however, cameras mounted on each side of the aircraft nose proved the skis were flexing at a high frequency between the front and back struts. This condition amplified ski vibrations causing a resonant frequency vibration in the airframe and specifically into the cockpit located directly above the front struts. Shannon reported vision loss from cockpit vibrations near lift-off speeds.

In order to test a series of ski modifications to reduce vibration problems, the fixed wheels were removed and a structural modification was made on the ski afterbodies that would permit relatively easy and quick configuration changes to the afterbodies.

This design, without wheels, mandated an auxiliary beaching gear requirement for aircraft ramp handling and water ingress and egress. The

BELOW, Shannon starts the taxi tests. The XF2Y-1 is traveling in the 15 to 20 knot speed range and "Sam" is conducting this test without benefit of a helmet.

ramp crew had to remove the gear after water entry and aircraft flotation, and then re-attach the gear upon the return of the aircraft to the ramp area. In addition, the solid rubber tail wheel was replaced by a solid steel wheel because of repeated rubber wheel failures.

When static in the water, all SeaDart aircraft floated with the trailing edge of the wing and the elevons being flush with the water, whereas the leading edge of the delta wing at the juncture of the fuselage was about eighteen inches above the water.

Many ski afterbody design changes were evaluated, along with main oleo and front strut shock absorption modifications. The greatest vibration reduction was achieved by using a fixed pointed afterbody. The plan view was a sixty degree included angle with a spur appearance. This design gave water penetration at high water speeds thus relieving the vibration. Because these ski modifications were not designed, fabricated or installed overnight, they often delayed consecutive tests for several days.

The test instrumentation on the XF2Y-1 was extensive, complex and state of the art for that era. Typical was for the photo panel installed in a fuselage compartment aft of the cockpit. Instrumentation was required for hydrodynamic, structural and aerodynamic evaluation as well as engine operation and environmental monitoring. Accelerometers were located at key points in the airframe, skis and especially the cockpit area for human factor purposes. The resulting data was recorded by cameras and oscillographs. Telemetry data was not used in the test program.

After each test, elaborate data analyses were conducted and compared with wind and water surface conditions for each taxi run, lift-off and touch-down through run-out. The testing involved considerable flight test and hydrodynamic engineering staffs in addition to aircraft maintenance and ramp crews plus instrumentation and photographic personnel. Convair "frogmen" removed and attached the auxiliary beaching gear and were aboard boats for pilot rescue in the event of an accident. During open sea tests, Navy surface craft and helicopters were present. Convair did not have a "bailed" or assigned Navy aircraft to support the XF2Y-1 flight test program during this early period. Flights were supported by a USAF T-33 jet chase aircraft and pilot from Edwards AFB on an as-needed basis.

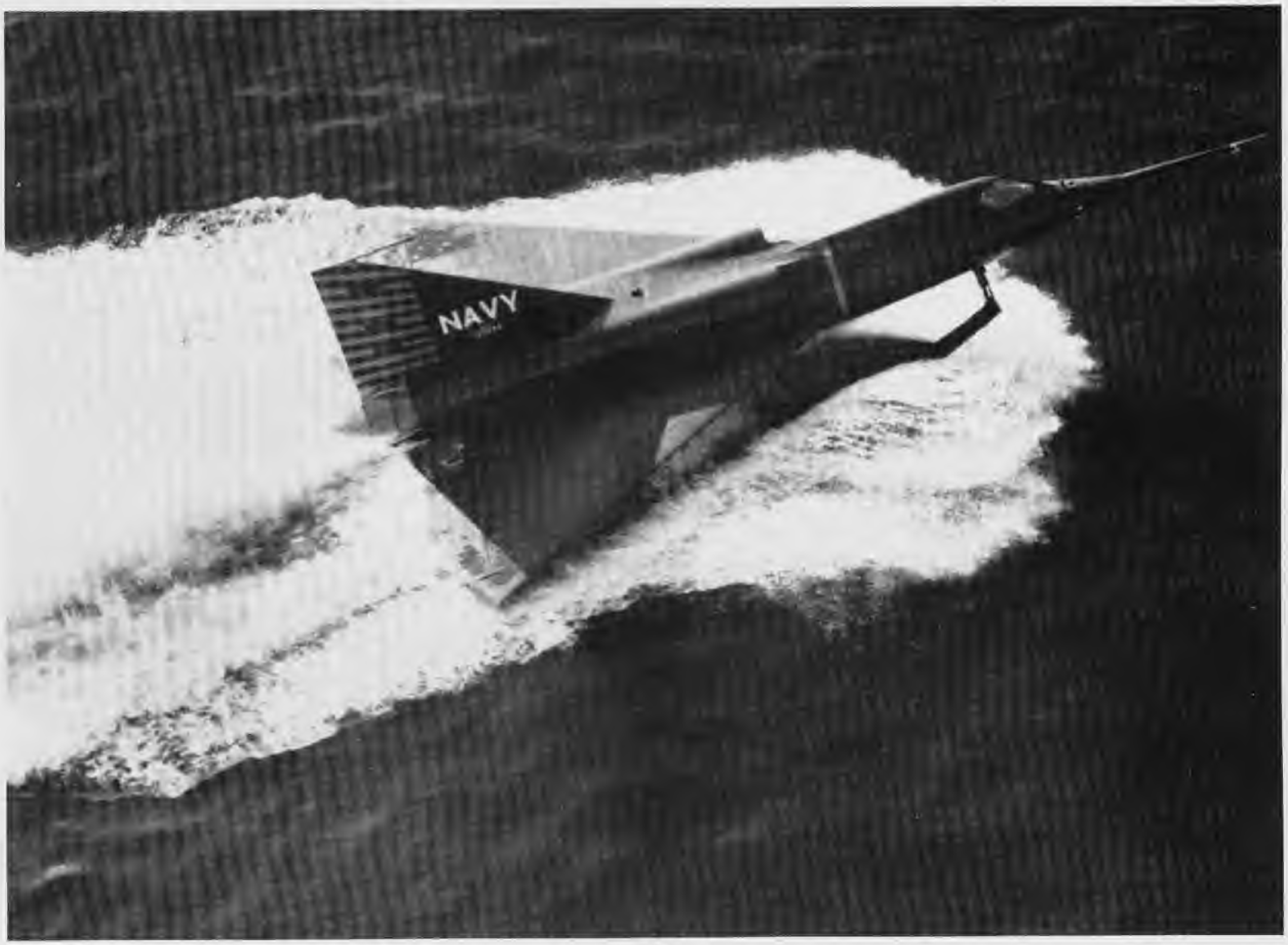
Aerodynamic testing of the XF2Y-1 was limited for several reasons. Thrust available from the non-afterburning J-34 engines was insufficient to provide the high speed performance projected for the SeaDart. The YF2Y-1, number two aircraft, was scheduled for completion in mid-1954 with the afterburning Westinghouse J-46 engines. These engines with greater thrust would provide a proper and more realistic evaluation of the SeaDart's aerodynamic performance. Concurrent with the SeaDart program, Convair was compiling aerodynamic performance data on delta wing aircraft through the XF-92A and YF-102 programs. The immediate need was to use the XF2Y-1 primarily to investigate a solution to the hydrodynamic induced vibration problem.

The twin-ski tests were concluded on the XF2Y-1 in mid-1954. All together, Shannon and Richbourg had conducted over one hundred and forty flight test operations on this aircraft in the twin-ski J-34 engine configuration. At this point the aircraft was returned to the factory for the installation of the afterburning Westinghouse J-46 engines and a large single-ski to replace the twin-skis.

Shannon taxis the XF2Y-1 back up Convair's seaplane ramp after the first taxi tests on 2-14-52. On the initial paint scheme, NAVY was painted in white under the port wing but the national insignia was missing on the underside of the starboard wing.

ABOVE, stern view of 137634 which shows the shape of the "Sugar Scoop" exhaust used with the J-34 engines, after returning from its first taxi test. The three wet rubber tracks of the ski and tail wheel can still be seen on the ramp (National Archives).

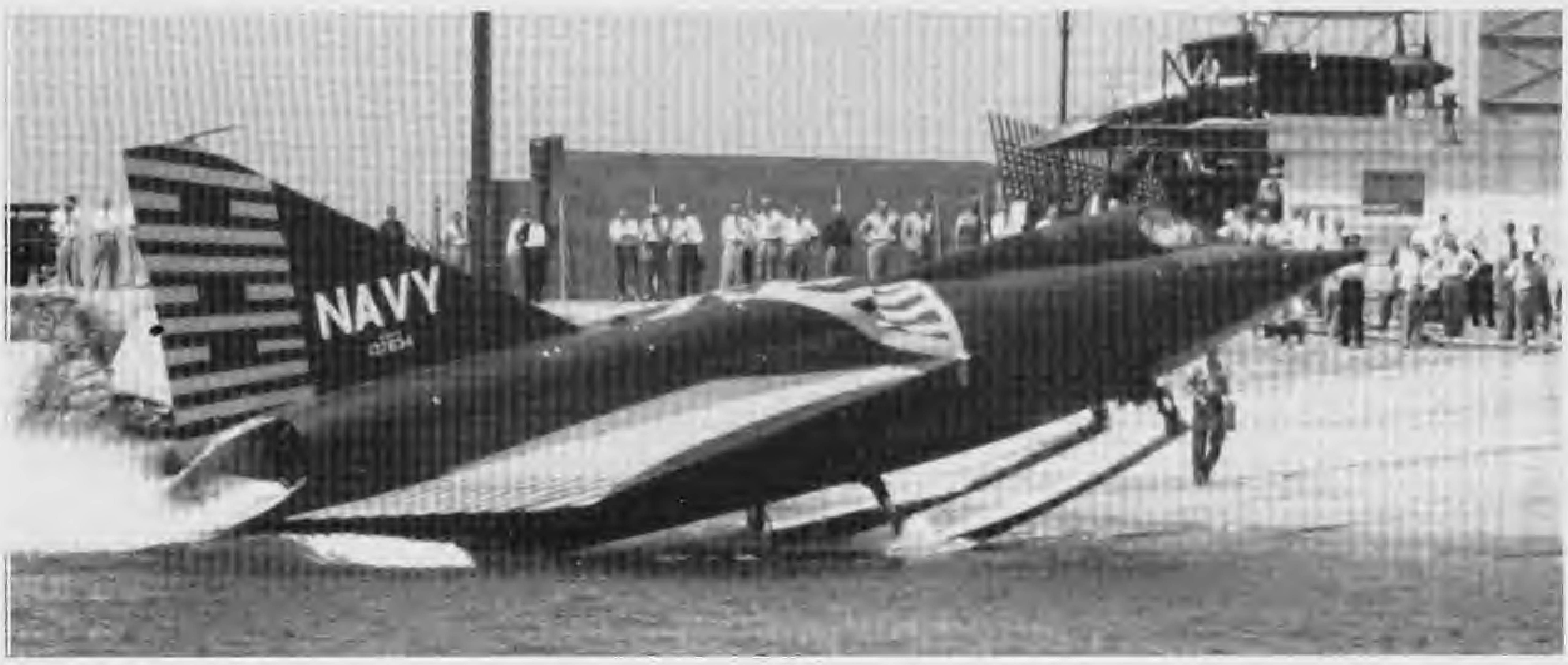
Early taxi test made by Shannon in the XF2Y-1. BELOW, 25 to 30 knots speed. AT RIGHT TOP, 40 to 50 knots. AT RIGHT BOTTOM, 50 to 60 knots. Aircraft is in its original scheme with yellow tail markings.



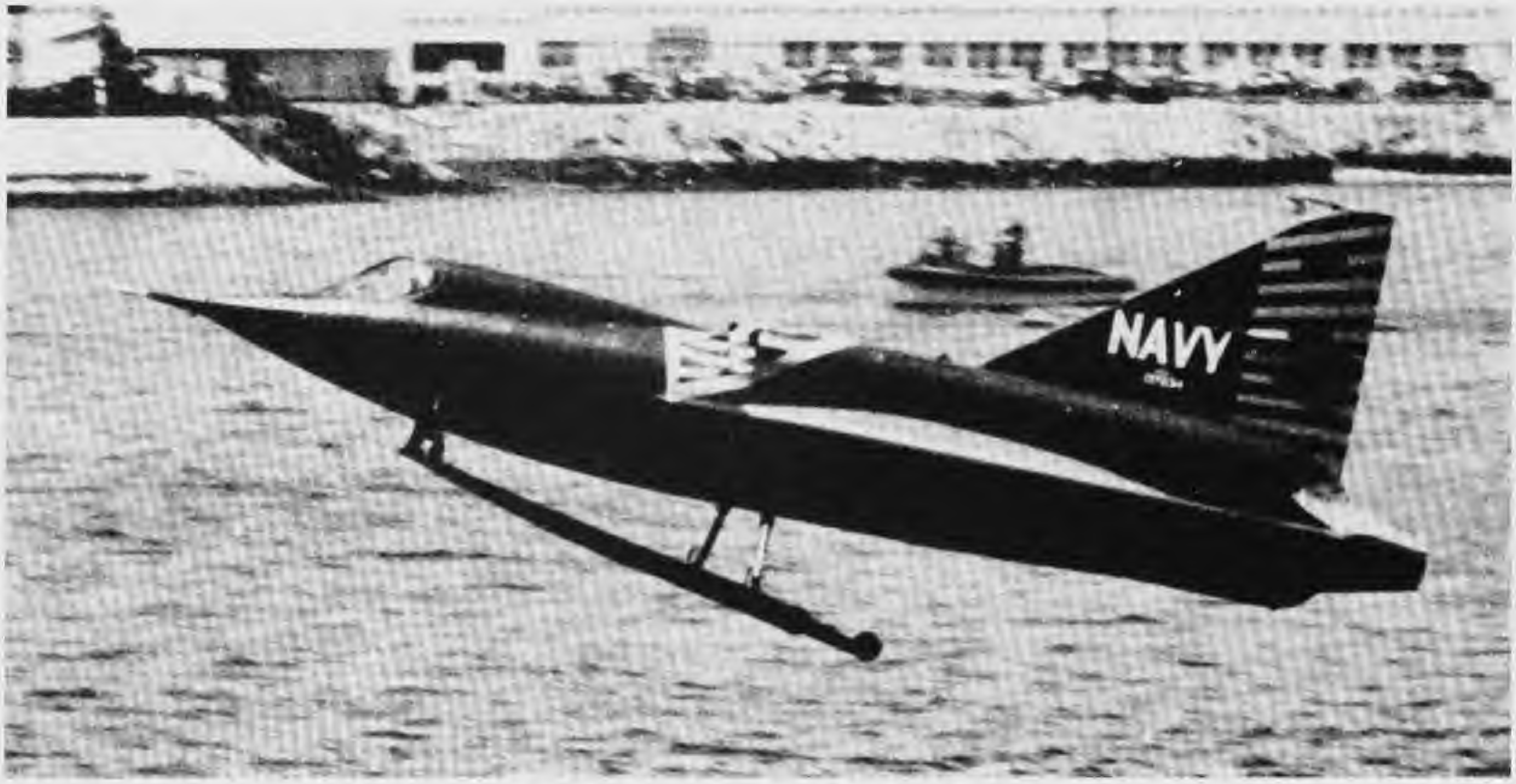

NAVY


NAVY

ABOVE, XF2Y-1 137634 with newer yellow enhanced wing and upper fuselage paint scheme being prepared for the first flight on 4-9-53. This photo shows the original ski wheel configuration. The stub nose was fitted temporarily after the aerodynamic test boom broke off from excessive vibration during an early high speed taxi test in rough water. AT LEFT, Shannon prepaes for the first takeoff with Gene Wigham Flight Test Engineer, standing at the right. Wigham had flown B-25s in World War Two. BELOW, Shannon taxis back up the ramp after the first flight with the R3Y engine test stand in the background.



ABOVE AND AT RIGHT, XF2Y-1 taxis out from the Convair seaplane ramp after the test boom had been replaced. BELOW, The first SeaDart banks away from the camera with San Diego Bay and Coronado Island in the background. The distinctive shape of the yellow underwing markings are shown in this view.



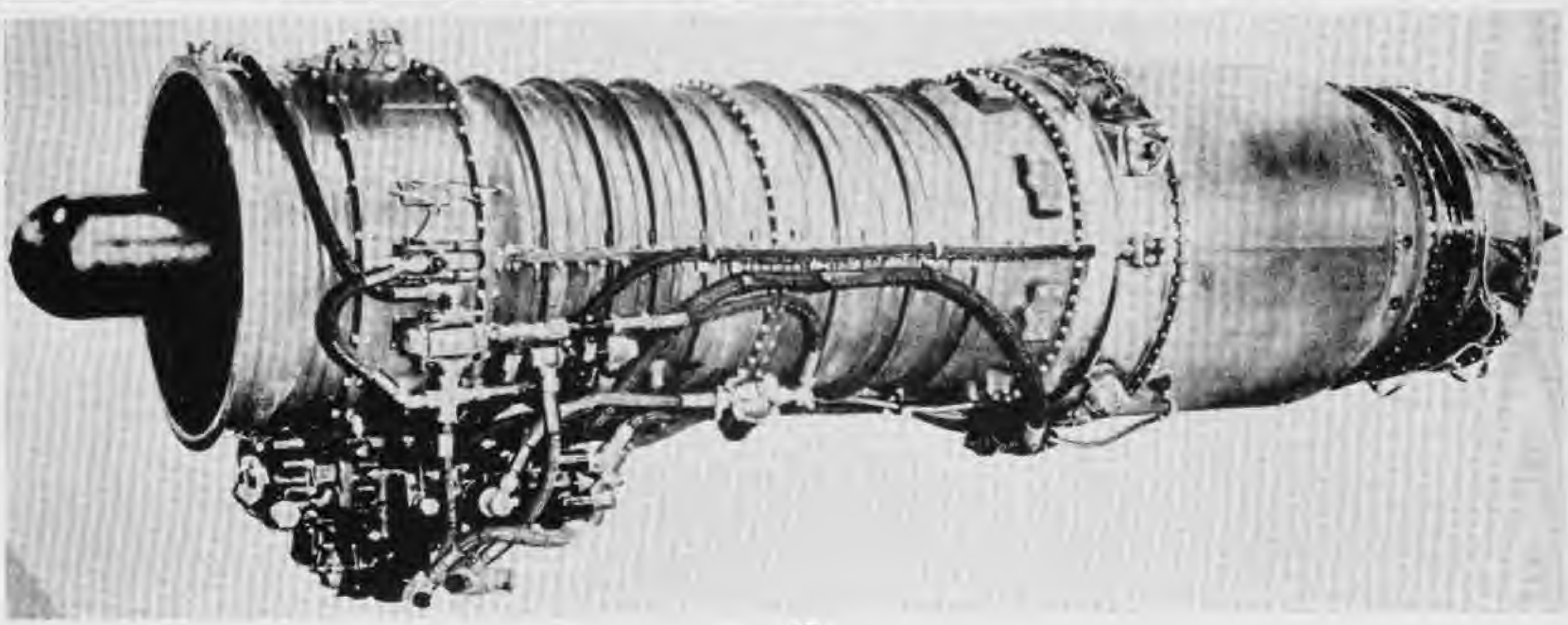
ABOVE, on 1-14-53 during a high speed taxi test, Shannon inadvertently became airborne for the first unofficial flight. Note the nose high attitude and fully extended skis for touchdown or lift-off. The small boat in the background was the Convair photography boat. The complex beyond the boat belonged to Ryan. AT LEFT AND BELOW, the XF2Y-1 taxis up the Convair ramp under its own power with palm trees and the Coast Guard Station in the background.

ABOVE, during take-off runs, ski oleos remain in the intermediate position until about 50 to 60 knots as shown here during an XF2Y-1 test run. The ski oleos would then be fully extended for the remainder of the run through lift-off. NAS North Island is in the background.

BELOW, rare photo of XF2Y-1 after different ski configurations were tested and the auxiliary beaching gear was developed and utilized. With the auxiliary beaching gear installed the aircraft could not taxi up the ramp under its own power, it had to be towed.

XF2Y-1 137634 COCKPIT DETAILS, INSTRUMENT PANEL

WESTINGHOUSE J34-WE-32 TURBOJET NON-AFTERBURNING ENGINE AS USED DURING TWIN-SKI TESTS IN XF2Y-1 137634



XF2Y-1 137634 COCKPIT DETAILS, LEFT HAND PILOTS CONSOLE

XF2Y-1 137634 COCKPIT DETAILS, RIGHT HAND PILOTS CONSOLE

SEADART NUMBER TWO, YF2Y-1 Bu No 135762 (TWIN-SKI)

In mid-1954, as the XF2Y-1 was being returned to Convair's Lindberg Field main plant for major modifications, the newly assembled YF2Y-1, number two aircraft, arrived at Convair's seaplane facility. This transition was scheduled to provide continuity in the SeaDart program.

In appearance this new aircraft was similar to the XF2Y-1 except for the installation of afterburning Westinghouse J-46 engines. The aft fuselage at the engine exhaust area was significantly different with the engine nacelles and nozzles extending further aft. The color scheme was the same as the final XF2Y-1 twin-ski scheme with the exception of minor stencil box differences.

This number two aircraft, except for the engine replacements, was really another "X" aircraft. It too was extensively instrumented for hydrodynamic and aerodynamic testing as was the XF2Y-1. This new aircraft would also continue the test program to reduce twin-ski vibration experienced in the XF2Y-1. Thus the twin-ski afterbodies were configured without wheels the same as the XF2Y-1 had been modified at the end of its twin-ski test program. This configuration would also permit afterbody changes but again required an auxiliary beaching gear for ramp handling and for water ingress and egress.

This aircraft provided the first opportunity to evaluate the real aerodynamic performance potential of the SeaDart with the greater thrust of the J-46 engines (6,000 pounds each with afterburner). These engines would also reduce take-off distance of the number two SeaDart as compared to the XF2Y-1 with its non-afterburning J-34 engines (3,400 pounds each).

Charles Richbourg was now the SeaDart Project Engineering Test Pilot with Shannon as back up pilot. Richbourg made the initial flights on the number two aircraft and then began to explore high speed performance plus aerodynamic stability and control characteristics. He continued limited twin-ski configuration testing on this aircraft but on a non-interference basis with the aerodynamic testing. He and Shannon began open sea tests several miles south of Point Loma with this number two aircraft.

Open sea tests became quite involved with support and standby rescue boats and auxiliary craft plus aircraft. At least one helicopter and one chase plane were required for safety, chase, and photo coverage.

A SeaDart ship recovery concept was evaluated with a large Navy

SeaDart Project Engineering Test Pilot, "Chuck" Richbourg in the YF2Y-1, number two aircraft, during a take-off run with engines in afterburner and at a speed of about 50 knots (57.5 mph).

Landing Ship Dock vessel (LSD). The first recoveries were made in San Diego bay in relatively calm water; ie, no waves or swells. The aircraft could not enter the LSD's flooded docking area, or "well", under its own power. Lines were secured to front and aft attachment points on the aircraft. The SeaDart was then towed into the LSD well very carefully because of the close tolerance between the wing tips and the LSD hull of about six feet on each side. Frogmen stood on the wing surfaces with fending poles to insure that no wing contact with the hull occurred.

Recovery in the open sea test with the LSD was most difficult because of wind conditions and ocean ground swell movement and the relative motion between the ship and aircraft. It was quickly concluded that recovery with this size LSD was unsatisfactory. Possibly with a much larger ship and improved recovery and handling techniques, such recoveries might have been more practical.

Above, Richbourg returns to San Diego bay with his skis "down and locked". Note skis have no wheels. The SeaDart is passing over downtown San Diego with Balboa Park in the background.

Below, YF2Y-1 135762 is carefully and slowly towed into a Landing Ship Dock (LSD) in San Diego bay before attempting the same test in the open sea. Note frogmen standing on the wings with fending poles. At right, on land behind a fence, the R3Y Tradewind flying boat is visible.

Richbourg had performed all of the LSD tests.

Richbourg continued flight and twin-ski tests on the number two aircraft and on 3 August 1954 he exceeded Mach 1.0 in a shallow dive at 34,000 feet. Flight testing continued on this YF2Y-1 through the fall of 1954. During some of these tests, yarn tufts with paint tips were glued to the upper wing surface at various locations and on the aft fuselage nacelle areas. Tests results indicated some wing span-wise airflow and air flow separation in the aft airframe areas. As a result of these tests, a single air flow fence was mounted on each wing upper surface near the tip. These fences were not installed on any other SeaDart. Wing air flow fences became standard on all delta wing F-102 aircraft.

On 4 November 1954, the Navy and Convair scheduled a bold flight demonstration of the Navy's "Mobile Base Concept" aircraft. National press members were invited to witness flights of Convairs XFY-1 "Pogo" tail setter vertical take-off and landing aircraft, R3Y Tradewind turboprop flying boat, and the YF2Y-1 SeaDart. At this point in time the XFY-1 Pogo had made only one previous horizontal flight.

At dawn that fourth of November, I flew our "bailed" Navy AD-5 "Skyraider" aircraft from Lindberg Field to the Brown Field area near the Mexican border where the XFY-1 Pogo with James F. "Skeets" Coleman, Project Engineering Test Pilot and LTCOL USMCR, would make the second horizontal flight that morning for the visiting military "brass", Convair management, and a large press contingent. I did not land but recorded temperatures aloft from 500 feet up to about 5,000 feet. The XFY-1s turboprop engines were very temperature and altitude sensitive with rapid power loss from increase in temperature. Thus an early morning flight was mandatory. After the Pogo demonstration, the dignitaries would travel to Convair's seaplane ramp for a low level eastward fly-by of the R3Y Tradewind scheduled shortly after noon. Convair's Donald Germeraad, Chief Engineering Test Pilot and CAPT USNR, would be the pilot with Jack Elliott, Convair Engineering Test Pilot as the copilot. The remainder of the crew were to be Convair Flight Test Engineers. The last event scheduled that day would be a low level westerly fly-by of the YF2Y-1 SeaDart piloted by "Chuck" Richbourg, Convair's SeaDart Project Engineering Test Pilot.

The XFY-1 Pogo and R3Y Tradewind flight demonstrations were conducted on schedule and were most successful and spectacular. The YF2Y-1 with Richbourg was now ready for the final demonstration. The massive R3Y made a dramatic backdrop on the seaplane ramp for the SeaDart. The Navy, Marine Corps, Convair and the press were prepared and anxious to see the final element of the Navy's Mobile Base Concept aircraft in action.

Convair's YF-102A USAF SN 53-1787 was the first actual aircraft to incorporate the NACA area rule design for transonic drag reduction. Notice the aerodynamic wing flow fences similar to those on the number two SeaDart. This photo provides a delta wing aircraft design comparison between the SeaDart and the F-102A. My pilot's log book shows that on 27 September 1956, I made my first F-102A flight in this same aircraft.

Early on 4 November 1954, the XFY-1 "Pogo" made its take-off for the second horizontal flight at the Navy's Brown Field. James F. "Skeets" Coleman, "Pogo" Project Engineering Test Pilot and LTCOL USMCR, made a most spectacular flight as part of the "Mobile Base Concept" aircraft demonstration that day. His flight was followed by that of the R3Y and Richbourg in the number two SeaDart.

The number two aircraft did not have integral ski wheels and had to utilize the ungainly looking auxiliary beaching gear. This aspect distracted from the intended mobility of the SeaDart but no one seemed to care. After water entry and flotation, frogmen removed the beaching gear and Richbourg proceeded to taxi for take-off position within sight of the ramp.

On the afternoon of 4 November 1954, the beautiful R3Y Tradewind turboprop flying boat made a very impressive fly-by over San Diego bay near Convair's seaplane facility. "Don" Germeraad, Chief Engineering Test Pilot, was in the left seat with Jack Elliott, Engineering Test Pilot in the right seat.

I was flying the AD-5 over San Diego bay and Lindberg Field area at the time to make sure the fly-by area was clear of other aircraft and to check the SeaDart as it became airborne.

Richbourg made a spectacular take-off run, retracting the skis immediately after lift-off. I dived the AD-5 down to a position under the YF2Y-1 to verify that the skis were up and apparently locked, being flush with the airframe hull. I reported this to "Chuck" and the SeaDart accelerated rapidly leaving me well behind in my big propeller driven attack aircraft. I then took up a circling position about 1,500 feet over Lindberg Field as I was on the same radio frequency with Chuck and the Lindberg control tower.

Richbourg soon reported that he was over the city of El Cajon east of

Above, the afternoon of 4 November 1954, the day of his last flight, Richbourg, in the number two SeaDart with the canopy open, readies for water entry with the auxiliary beaching gear attached. The R3Y flying boat is behind the YF2Y-1, having completed an earlier flight demonstration.

Below, the "mule" tow tractor is hooked up to tow the SeaDart to the head of the seaplane ramp.

YF2Y-1 at water's edge for its pending fatal flight. Clearly visible are the ski afterbodies, auxiliary beaching gear, and frogman on the wing who will release the gear when the aircraft is afloat. A safety cable is attached to a hook on the speed brakes/water rudders as a safety and restraining device until the aircraft is afloat with beaching gear removed. Richbourg will then open the speed brakes momentarily to release the cable. Below, canopy is open for visual communication with the frogmen.

Last close up photo of Richbourg and the number two aircraft at a slow taxi from the seaplane ramp on 4 November 1954. Several aircraft details are very visible: the aerodynamic test boom on the nose, hydrodynamic spray rail below the cockpit and just above the water line, small air inlet "suck-in" doors behind the engine's main inlet ducts, and the wing flow fences on both wing tips that were added after high subsonic flights revealed some span wise air flow. This was the only SeaDart having these flow fences installed.

San Diego and starting his westward fly-by run. I advised the area was clear.

Looking downward I could not see "Chuck" approaching but suddenly saw the ball of fire and aircraft elements streaking in a downward trajectory and impacting in the bay.

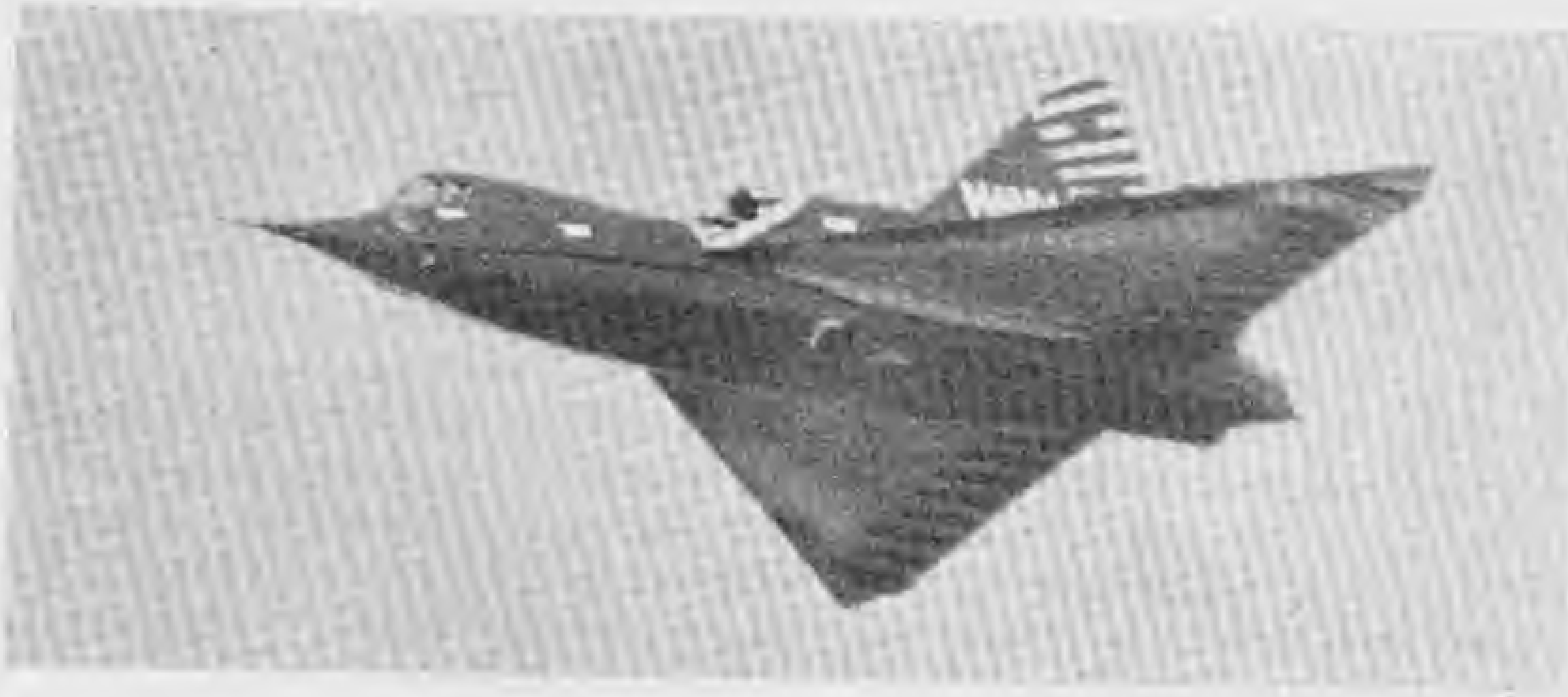
The SeaDart's velocity was about 500 knots (575 mph) when it passed over the San Diego Civic Center and fired the afterburners. With the engine thrust lines located at a high position on the aircraft, the sudden application of increased power induced a nose down pitching moment which Richbourg instantly attempted to correct by back control stick movement. The SeaDart flight controls were a "full-power" hydraulic system like all supersonic aircraft designs at that time. Without such a system pilots could not fly the aircraft because of extreme and unacceptable control forces. These systems also had a center trim "detent" position with movement from that detent requiring slightly more pilot control force input than required for movement after the control stick is out of the detent position. This is referred to as control stick "break-out" force. Not to mention the inherent lag in the control system from pilot input to control surface movement.

All of these factors contributed to and resulted in an aircraft divergent longitudinal pitch oscillation that structurally broke the SeaDart apart during the second nose-down pitch. The wings broke in negative bending with airframe break-up and engine

"Chuck" departing the seaplane ramp area at a slow 5 to 6 knots. Skis are still fully submerged. (National Archives)

DEMISE OF THE # TWO SEADART AND CHARLES RICHBOURG

At right, photo taken just as the wing cracks at the root. A jagged line can just be seen running through the yellow paint where the wing is blended to the fuselage. (San Diego Historical Society)



separation following.

This accident was a classic example of the divergent pitch oscillation caused by combinations of high speed at low altitude (high dynamic pressure), early full power flight control system characteristics and pilot inducement or "PIO" (pilot induced oscillation). This accident had no bearing on the fact that the SeaDart was a seaplane or that it had any unusual design deficiencies. This type of accident occasionally occurred in other supersonic aircraft even years later in much more advanced supersonic aircraft.

As the SeaDart broke apart, the fuselage behind the cockpit separated with one ski still attached by the front strut and impacted inverted in the bay near the Convair rescue boats. Richbourg was killed by the impact and was immediately recovered by the frogmen.

Because of the crash all SeaDart operations were temporarily suspended until the Navy accident board had completed its investigation.

Middle, SeaDart number two breaks apart over San Diego bay during the high speed fly-by demonstration. The structural failure was followed by explosion from fuel. The forward fuselage with the cockpit intact and one ski still attached appears inverted and pointed opposite to the flight path from left to right. One engine is visible at the right and a major portion of the airframe structure appears at the bottom of the fireball.
At Right, USCG chopper approaches the Convair rescue boat with Richbourg in back. (San Diego Historical Society)

SEADART NUMBER ONE, XF2Y-1 Bu No 137634 (LARGE SINGLE-SKI)

On 29 December 1954, fifty-five days after the crash of the YF2Y-1 number two SeaDart, I climbed into the cockpit of the XF2Y-1 for the first test of the large single-ski since Richbourg's accident. The test was to be a continuing evaluation of the large single-ski oleo configuration that had produced unacceptable hydrodynamic stability and control characteristics during Shannon's and Richbourgh's previous tests. This would be FTO-151 (flight test operation) for the XF2Y-1. 151 was the combined number of tests for the XF2Y-1 twin-ski original configuration and as modified for the single-ski configuration up to that point in time. Only about a dozen tests had been conducted on the single-ski by Shannon and Richbourg prior to this, my first test.

It was the first time I had actually been in a SeaDart cockpit. I was there because Shannon had a mild illness and could not conduct the test operation. CAPT F. K. Slason USN, Convair BuAer senior representative authorized me to make the test even though my official clearance from Washington, D. C. had not yet arrived. Though I thought I would receive Navy Department approval, I had been reluctant to sit in the cockpit prior to actual approval. But, there I was in the cockpit ready to take the SeaDart into the bay for FTO-151.

Access to the SeaDart cockpit was gained via a large mobile and adjustable steel step ladder with a platform at the top. From the platform it was easy to step into the cockpit. There were no aircraft handholds or steps for entry.

The cockpit canopy design and opening geometry were similar to the X-15. The canopy structure was hinged from behind the cockpit. When open there was no wind screen in front of the pilot. Visibility out of the small "V" windshield was acceptable for a research aircraft but would have been totally unacceptable for a combat aircraft. The windshield size and placement was poor for providing outside light in the cockpit and especially the pilot's consoles. With bright sunlight, it was often difficult to see cockpit items and the prospects of pilot ejection with this canopy arrangement even at low airspeeds seemed very undesirable.

Cockpit layout was conventional and acceptable for jet aircraft of that period except for the use of the ski wheel brakes. The brakes were not activated by conventional toe movement on the rudder pedals. Instead there were two side-by-side levers at the forward portion of the right console that were hand pulled separately or together for steering or braking on the seaplane ramp. This wheel braking device was awkward and unnatural for a pilot. Conventional toe brakes on the rudder pedals should have been used.

The ejection seat system was assembled according to USN military specifications with the Navy providing components including the catapult, tube, rails, and cartridges with Convair fabricating the seat. It was state-of-the-art for Navy ejection seat systems during that era and did not provide for safe low level ejection. Typical of Navy ejection seats, as different from USAF systems, it was actuated by the pilot reaching up over his head and pulling the curtain down over his head and face. This deployed the canopy followed by the seat. The large curved metal tubes on the side of the seat would keep the pilot's legs in place during ejection.

The canopy could be closed and opened by the pilot. To close it, the pilot pulled down on a padded handle in the top center of the canopy with his right hand. When fully closed the pilot locked it with his left hand using the canopy lock and unlock handle at the left side of the instrument panel. It was opened by the pilot using the reverse procedure. The canopy was spring loaded not to fall shut. The canopy could be operated by the ground crew using external access devices and the canopy could be jettisoned from an external source for emergency or rescue purposes.

The two afterburning (AB) axial

"Sam" Shannon in the large single-ski equipped XF2Y-1 as he prepares for a early test. Shannon and Richbourg had completed about a dozen tests with the single-ski when B. J. Long took over the testing. Note the down turned outer edges of the ski and the instrumentation cameras on each side of the nose which were used to record the ski spray patterns. The clamshell style X-15 type canopy is also evident in this photo.

The Westinghouse J-46 afterburning engine which replaced the J-34 in the XF2Y-1 and all subsequent YF2Y-1s.

flow Westinghouse J-46 engines had many design and operating features that were different from other engines of that era. The engines were started with an auxiliary compressed air powercart. Engine restart was not possible without the external source even with one engine operative. If in the water, a boat with such a power source was required, otherwise the aircraft had to be towed home. The SeaDart could not be steered in the water with one engine inoperative. Late in the program I evaluated temporary bottom extensions to the water rudders, but steering improvement was not apparent and they were removed.

The engines were designed to meet the needs of Navy carrier based aircraft such as the F7U Cutlass. Tail pipe temperature (TPT), fuel flow and engine exhaust nozzles were electronically controlled. Above about 50 percent thrust the engines ran at 100 percent RPM. Thrust was then increased further by fuel flow and the nozzles closing as the throttles were advanced. If the engines were at 80 to 90 percent thrust, further thrust increases were instantly available with throttle movement since no RPM "wind-up" was required. This feature was particularly desirous if a carrier aircraft had to take a "wave-off" from landing. Afterburner firing was acquired when the throttles were advanced rapidly past the full (non AB) throttle dent or position. Thrust in the AB mode could be modulated. AB was cut-off by moving the throttles back past the dent position.

Since engine TPT, fuel flow, and nozzle positions were electronically controlled or regulated according to the pilot's throttle position, electrical power loss required an engine alternate control system. With an AC power failure the engine exhaust nozzles opened wider and fuel flow was reduced according to throttle position. This was termed a "hot day" setting and insures that theTPT was not exceeded. An alternate or other generator could be selected for return to the electronic control system. With such an electrical power failure, there was an instant and significant loss in engine thrust with or without afterburner and a corresponding abrupt decrease in airspeed.

The engines had magnesium compressor cases which were affected by salt water contamination. The inside walls of the cases would grow whiskers from the contamination until the compressor blades scrapped the walls. This condition required periodic cleansing. In addition to spraying large amounts of fresh water into the idling engine, small particles of walnut shells were injested into the engine. This method produced effective results. It was also standard procedure to spray fresh water into the inlet ducts at idle RPM upon returning to the ramp.

In this configuration the aircraft sat on three "beach" wheels in a tail low attitude. The two ski wheels were retractable and had a sixteen inch outside diameter hard rubber tread. The swivel steel tail wheel was ten inches in diameter and had replaced a hard rubber wheel used early in the test program because of the repeated failures of the rubber wheel.

Taxi down the seaplane ramp into

B. J. Long in the XF2Y-1 single-ski configured aircraft enters San Diego Bay during a test evaluation.

the water was made with the ski in the beach or full-up position for aircraft attitude purposes. Upon attaining floatation the wheels on the ski afterbodies were retracted by a cockpit electrical switch on the left console. Hydraulic action positioned the wheels on the upper surface of the single-ski afterbody in a retracted position.

During the transit down the ramp into the water, the aircraft was restrained by a cable for safety purposes. The cable was attached to the split hook on the aft edge of the aerodynamic speed brakes (also used as water rudders) and attached to a tow tug on the ramp. With flotation the pilot released the cable by opening the speed brakes.

As I entered the water and began my first test, I felt very comfortable and self assured in the SeaDart and the water environment. This confidence was based on my rather extensive experience during World War Two flying Navy single engine seaplanes with over 300 hours in the Vought OS2U Kingfisher and Curtis SC-1 Seahawk floatplanes. This confidence was further aided by my post war experience in several Navy jet types with active drone units and reserve squadrons.

In SeaDart testing certain unique nomenclature was used to describe or document water operations. When in contact with or in the water, aircraft and ski longitudinal attitude angles relative to the water were termed "trim angles". When the ski broke the water surface, it was termed "ski unporting" or "ski emergence".

This large single-ski was very rigid with no mid-point deflecting. The bottom was a shallow V in cross section with a ten degree deadrise. The afterbody was tapered in plan form at a sixty degree included angle for water penetration. The outer edges of the ski had flanges or lips extending downward past the bottom surface of the ski. These flanges deflected water downward reducing spray and providing additional hydrodynamic lift.

Remember, this large single-ski and the twin-ski configuration were water planing devices not hydrofoils. With the single-ski, lateral stability and control was achieved because of water being impinged on the underside of the wing surfaces and elevons. As the aircraft approached lift-off speed, aerodynamic forces added to the hydrodynamic forces.

The single-ski installation was not designed or intended to be fully retractable as were the twin-skis, because high speed flight was not planned or needed. This ski was being evaluated only to demonstrate its hydrodynamic qualities for application to the SeaDart delta-wing design as a water based seaplane fighter. The previous twin-ski "wells" or fuselage hull cavities for twin-ski full retraction were not filled or covered for the single-ski installation. The ski could only be retracted to an external position parallel to the aircrafts longitudinal axis. Aerodynamic drag in this position was acceptable for slow cruise flights to and from open sea test sites.

With the ski in the intermediate position, idle speed was about two to three knots. If the aerodynamic speed brakes on the fuselage afterbody, below the engine exhaust area, were opened and the ski was fully extended the speed was reduced to about one knot. The speed brakes were activated by a switch just inboard of the throttles on the left console. Each brake panel opened outward sixty degrees. The speed brakes were also used as water rudders at very low speeds or speeds below ski unporting. By depressing a switch on the pilot's control stick and actuating the rudder pedals, the brake panels became water rudders opening to a maximum of thirty degrees on each side and relative to rudder pedal movement.

I conducted extensive water maneuvering evaluations at various speeds. The combined use of asymmetric power, water rudders, and lateral control was very effective in executing tight turns in the water at speeds of fifteen to twenty knots. Above that speed lateral control or banking was best. I used the water rudders only when maneuvering at

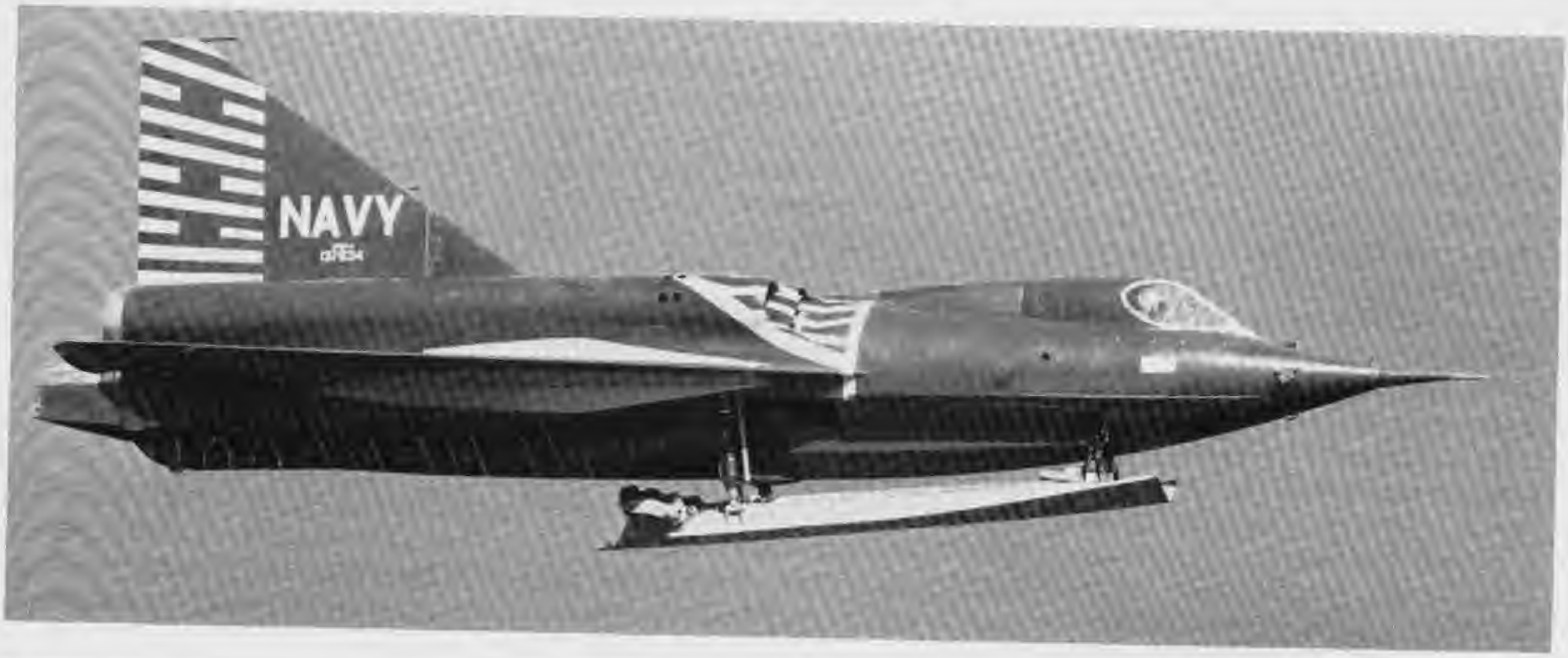
Top two photos at right show the large single-ski in the full up position while enroute to an open sea test site. Clearly visible are the one and two foot yellow stripes on the bottom of the ski and the hull afterbody. These were used to verify design regarding wetted lengths at various water speeds. Also visible are the down turned flanges on the outer edges of the ski.

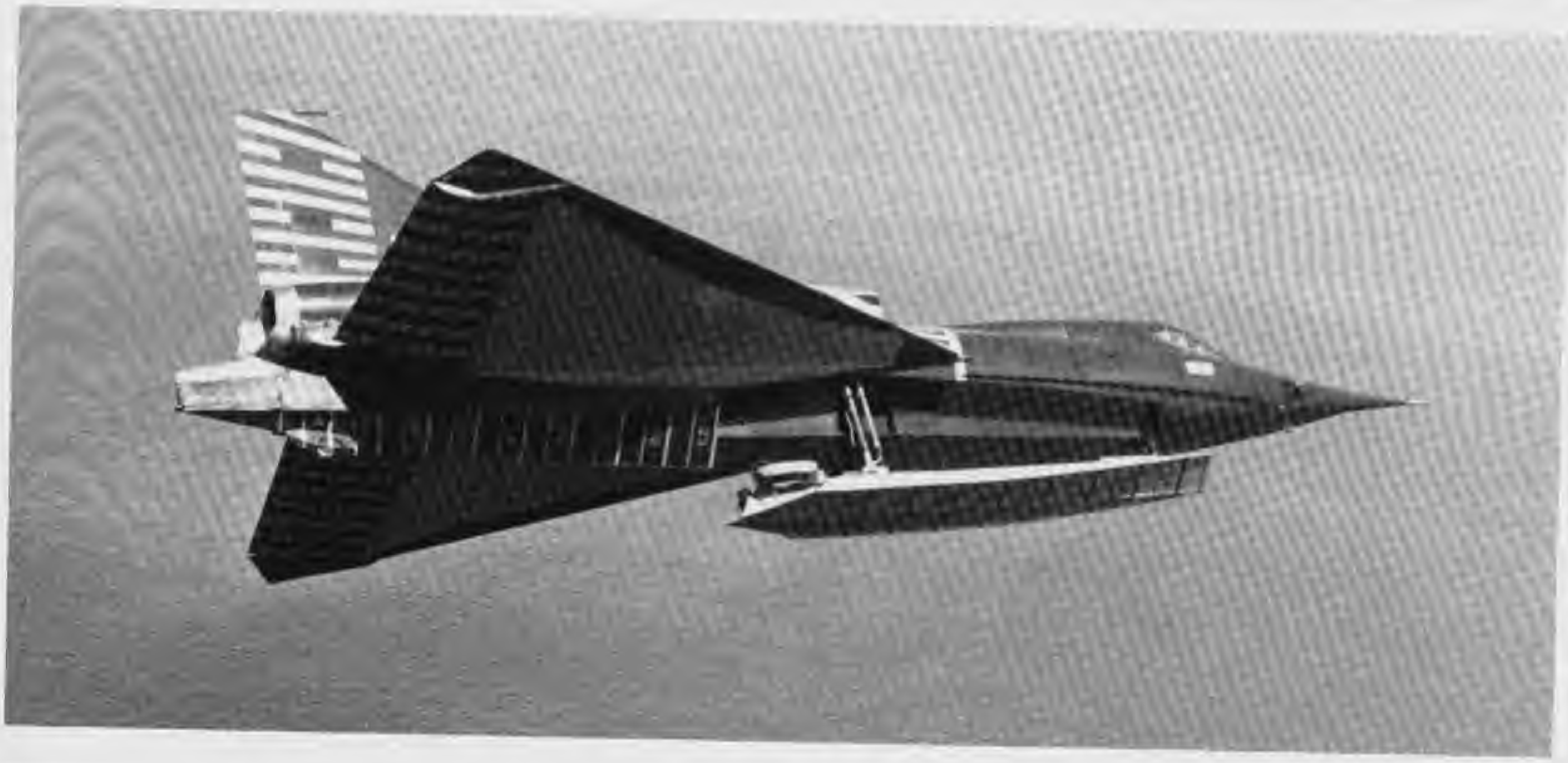
Bottom photo shows the ski fully extended in preparation for open sea landing and take-off operations. The "suck-in" doors located aft of the engine intakes are open to provide additional air flow into the engine compressor area during low airspeeds such as during landing.

low speeds below five or six knots or when departing and approaching the ramp.

Ski positions were selected by an electrical switch on the left console forward and inboard of the throttles. To commence a take-off, the ski was initially placed in the fully extended position and military power applied (full throttle without afterburner). The high trim angle of the ski caused the ski to unport or break the surface at eight to ten knots. The ski was then placed into the intermediate position for hydrodynamic drag reduction and the afterburner was ignited so the aircraft could start the take-off run. It was best to let the aircraft assume a natural pitch attitude up to about forty or fifty knots, then select the fully extended ski position. From this point, optimum pitch attitude and pilot technique were used considering wind and water surface conditions. At one hundred and twenty five knots the aircraft was sharply rotated to a nose up attitude of seventeen to nineteen degrees for lift-off. The ski up and down lever was then brought to the up position if extended flight was desired. For landing the ski had to be in the extended position. This was the take-off and landing procedure for both the single and twin-ski configuration.

Full extension of the ski (or skis) provided proper height and geometry of the aircraft over the water for longitudinal control and high nose up attitudes such that the aircraft afterbody did not drag in the water


NAVY




NAVY

preventing forward acceleration and rotation for lift-off.

In relatively calm water or small wind waves, take-off time and distance could be reduced by holding an almost level aircraft pitch attitude with ten to fifteen degrees down elevator (elevon). With these settings, take-off times and distances averaged twenty five to twenty eight seconds and 2300 feet respectively. In rougher surface or cross wind conditions, higher nose up attitudes were more desirable from a safety aspect but increased take-off times and distances.

During my first XF2Y-1 single-ski test, I encountered the same divergent and uncontrollable hydrodynamic longitudinal pitch oscillations experienced by Shannon and Richbourg in their few early tests. The pitching motion was so severe that I aborted the runs at forty to fifty knots. I also experienced lateral directional stability and control problems. In a cross wind run, the aircraft would "lean over" and turn downwind while dragging the downwind wing tip in the water. The downwind turning could not be controlled and runs were aborted.

At the time of my first test, a new ski oleo damping device was being assembled that would sense stroke rate and vary the oleo hydraulic orifices and provide needed damping qualities. I soon tested the new system and experienced excellent oleo damping and no uncontrollable pitch oscillations, however directional stability and control were still a problem. To correct this problem I recommended doubling the lateral deflection of the elevons relative to pilot control stick movement. This change solved the hydrodynamic lateral directional control problem with excellent results. High airspeeds with a fully retractable ski would have required a lateral control ratio changer, otherwise lateral control would be too sensitive causing the pilot to overcontrol. This gets into what is called "control harmony". Roll control would have been excessive in relation to pilot's pitch and yaw control movement for high airspeeds.

With a delta wing design, control surfaces at the wing trailing edge provide both pitch and roll control and are called elevons. This term is derived from elevators and ailerons on conventional aircraft. The term "elevator" was used for pitch control reference purposes in the SeaDart program.

The single-ski two main oleos axes were parallel. This relationship provided smooth stroking of the oleos without a bending load being imposed. This was an improvement over the twin-ski oleo struts which did have bending loads in addition to their axial loads.

The new oleo damping devices and the lateral elevon deflection increase solved all earlier hydrodynamic stability and control problems. Now the task was to do a complete hydrodynamic evaluation of this large single-ski configuration.

The increased lateral control provided very positive hydrodynamic directional control by banking the aircraft at all water speeds, above ski unporting, in the desired direction of the turn. The technique was "motor-

The XF2Y-1 single-ski SeaDart enroute to the open sea test site. The ski is "fully retracted" with the wheels tucked in like a bird. Good view of engine exhaust area, hull afterbody design, speed brake sides, and tail wheel and fairing.

boating" in effect. During strong crosswind take-off and landing conditions I actually dragged the "into the wind" wing tip at lift-off and touchdown speeds of one hundred twenty five and one hundred twenty knots respectively with no adverse results. The wing low method for handling crosswinds was best for the single-ski aircraft. The wing tip was at a positive trim angle (angle of attack in the water) at all times with no submerging tendencies.

Including my first test, FTO-151 on 29 December 1954, I conducted eighty one test operations with the large single-ski XF2Y-1 during the following thirteen months, ending 16 January 1956 with FTO-245. This constituted eighty-six percent of all large single-ski tests conducted. During this period I made a total of one hundred and sixty-nine take-offs and touchdowns including five open sea test operations. Shannon and Navy test pilots had conducted the other thirteen tests. These data are mentioned because I want to express my appreciation for the opportunity to conduct most single-ski evaluations and provide all quantitative test data on this absolutely best of the SeaDart configurations.

In the conduct of performing the various flight test operations gathering both qualitative and quantitative test data, much was learned about aircraft handling qualities, optimum pilot techniques, and engine operations in sheltered water and open sea environment for these unique water based aircraft.

Tests described herein are not in order of importance or chronological sequence. Many test items were done on a sampling basis as part of each test operation. Test pilots and flight test plans should use every minute of every flight for evaluation and data gathering. From the time the pilot approaches the aircraft through engine shut-down and exit from the aircraft, qualitative and quantitative evaluations should be made.

In many cases, it is best to have only one pilot gathering quantitative test data in a series of tests for a particular area of evaluation and when special pilot techniques are required. This provides precise continuity in obtaining data. It is especially important when only one aircraft is available or when only one aircraft has the required test instrumentation onboard for the test being conducted. A single pilot also helps when test program time and funding are limited. It allows the pilot to acquire the technique in a minimum number of flights and to maintain the technique throughout that series of tests.

This learning curve method using one pilot was especially applicable for the high rate of sink landing tests required by the Navy. In San Diego Bay, I performed rates of sink up-to-and-including nineteen feet-per-second with no damage to the XF2Y-1 and no unacceptable or uncomfortable impacts felt in the cockpit. These tests required a "work-up" sequence starting with low rates of sink. Sink rate data were acquired with a photo theodolite camera tracking the aircraft

RADM James S. Russell, Chief of Navy Bureau of Aeronautics, chats with SeaDart test pilot B. J. Long after a XF2Y-1 single-ski flight demonstration. At right is CAPT F. K. Slason, Convair senior BuAer rep. and "Joe" Famme, Convair's assistant chief engineer. In the center is LCDR Eban Leavitt, aide to the Admiral.

from a land station normal to the approximate touch down point.

I conducted six such landings on the first day and then analyzed the camera data. I then knew the sink rates for the first day. This provided me with a feeling of height above the water for cutting power and aircraft attitude in obtaining specific ranges of sink rates. I completed this series of tests in four non-consecutive days and operations from 19 through 29 December 1955 with a total of twenty eight high sink rate landings. The last of these particular tests was FTO-242. Ironically that date was exactly one year from my first test in the SeaDart.

One high sink rate landing at 17.8 feet-per-second recorded a combined maximum oleo load of 48,200 pounds. The single-ski oleos were designed for a combined maximum load of 88,000 pounds.

I conducted a series of high speed taxi tests to investigate and determine wetted lengths of the single-ski and aft airframe hull at various water speeds. The purpose was to verify design data for this first and one-of-a-kind large single-ski configuration of a high performance delta wing water based aircraft.

Bold yellow stripes were painted across the bottom of the ski and bottom aft fuselage hull. The stripes were one foot apart and numbered at two foot intervals on each side of the dead rise of the ski and hull. Stripes and numbers started at the aft end of the ski with the forward most stripe at twenty one feet and about two inches short of the ski leading edge. Wider stripes denoted two foot intervals. Narrow stripes indicated one foot marks and were not numbered. The fuselage hull numbers measured from the aft tip of the closed speed brakes forward on the hull bottom. The first wide and numbered stripe was at six feet near the center of the tail wheel. The stripes ended with number twenty two on the hull and at a point about the aft end of the ski.

To conduct these tests, light weight water buoys with extended poles and high visibility flags were anchored in the bay about sixty feet apart. I performed a series of taxi runs at various speeds between the flags. An underwater cameraman located between the buoys photographed the ski and hull bottoms as I passed through the buoys. I cannot tell you how the cameraman stayed submerged at the proper depth. Water speed data for each pass were recorded by photo theodolite cameras positioned on land. Correlation of these data provided the desired information to verify design parameters.

My early tests with the modified ski oleos had demonstrated highly satisfactory longitudinal stability and control in the pilot's "stick free" mode. This means the pilot could move the control stick to damp pitch oscillations as with all seaplanes. It was necessary to determine aircraft inherent hydrodynamic longitudinal stability characteristics placing the control stick in a "stick fixed" mode for pitch.

"Stick fixed" was accomplished with a thin cable attached to each side of the pilot seat at waist height with a ring in the center. When tensioned forward the cable formed a "V" with the ring at the apex and just aft of the control stick grip at a elevator position of ten degrees up. Clips on the cable attached to the ring for easy release and safety purposes. Attached to the ring was a leather strap. I would then place the elevons in any precise up or down position by reference to the elevon position dial indicators on the instrument panel (not provided for in the YF2Y-1 number three aircraft because it was unnecessary)). The leather strap was then wrapped around the control stick grip at the same time the cable and strap were tensioned for the desired elevator position. This allowed aft movement of the stick if needed. Full throw of the stick forward was instantly available by easing grip pressure allowing the leather to slip.

This technique permitted a series of take-off runs to evaluate the inherent hydrodynamic longitudinal stability of the aircraft with "stick fixed" positions of five, ten or fifteen degrees down elevator; zero, five or ten degrees up elevator. I conducted all of these tests in San Diego Bay with mild surface winds, mild surface waves and confused boat wakes.

Mild divergent pitch oscillations occurred during the run with zero degree elevator position. The oscillations were not sufficiently severe to release the "stick fixed" position prior to lift-off rotation at one hundred twenty-five knots. This indicated an inherent unstable region with this elevator position and aircraft pitch attitude. A "stick free" run was made in this unstable region with no stability problems when the pilot could damp any pitching with slight movement of the elevators. This would permit normal operation in this region if desired with proper pilot techniques. Take-off time and distance decreased with increased down elevator positions. The fifteen degree down elevator run resulted in twenty four seconds to lift-off. Runs made with five and ten degrees up elevator increased the time and distance. The final run at ten degrees up elevon "stick fixed" required thirty one seconds to lift-off. I also conducted runs in ninety degree cross-winds up to twenty four knots using the wing low into the wind technique. The up wind wing tip was dragging in the water and the last portion of the aircraft to leave the water at lift-off. The wing low technique was comfortable, safe, and operationally satisfactory.

Water ingestion in the engines was not a severe problem if proper pilot techniques were used. However, normal operation in a salt laden atmosphere created problems. The XF2Y-1 instrumentation included gross thrust probe gauges. On several of my early test flights I was making consecutive take-off and touch down runs in opposite directions in the bay. During these runs I was very careful not to create spray from ski unporting and submergence. After five runs, I experienced an accumulated afterburner thrust decay of 2,000 pounds in each engine. Normal AB thrust was 6,000 pounds each so this was a forty percent loss of thrust. At this point I encountered engine compressor stall and instant excessive TPT when

attempting AB firing which required immediate power reductions. We knew this condition could be corrected upon return to the ramp. With the aircraft at idle power the maintenance crew would hose large quantities of fresh water into the engine ducts to cleanse the compressor and stator blades. The salt particles had dried on the blades and caused a severe disruption of air flow over the blades the same as ice or snow on an aircraft wing. The fresh water hosing restored engine efficiency and thrust.

Because of this engine contamination problem, a small fresh water tank of about twenty gallons was installed in the XF2Y-1 (and later YF2Y-1 number three SeaDart). The tank was mounted into the airframe "turtle back" behind the cockpit. Small metal tubes were directed from the tank to each engine air inlet duct. An electrical pump provided injection pressure for each engine. A three-way spring loaded switch was installed on the pilot's right console. The center position was off and depressing the switch right or left provided a small stream of fresh water in each engine while at idle RPM. A few seconds of pumping provided proper cleansing of the compressor and stator blades. This would completely restore full thrust capability. I used this procedure before every take-off and it proved most useful during open sea tests when rough water conditions usually caused heavy salt water ingestion during landing run-out. This system could make the difference in getting off or being towed home.

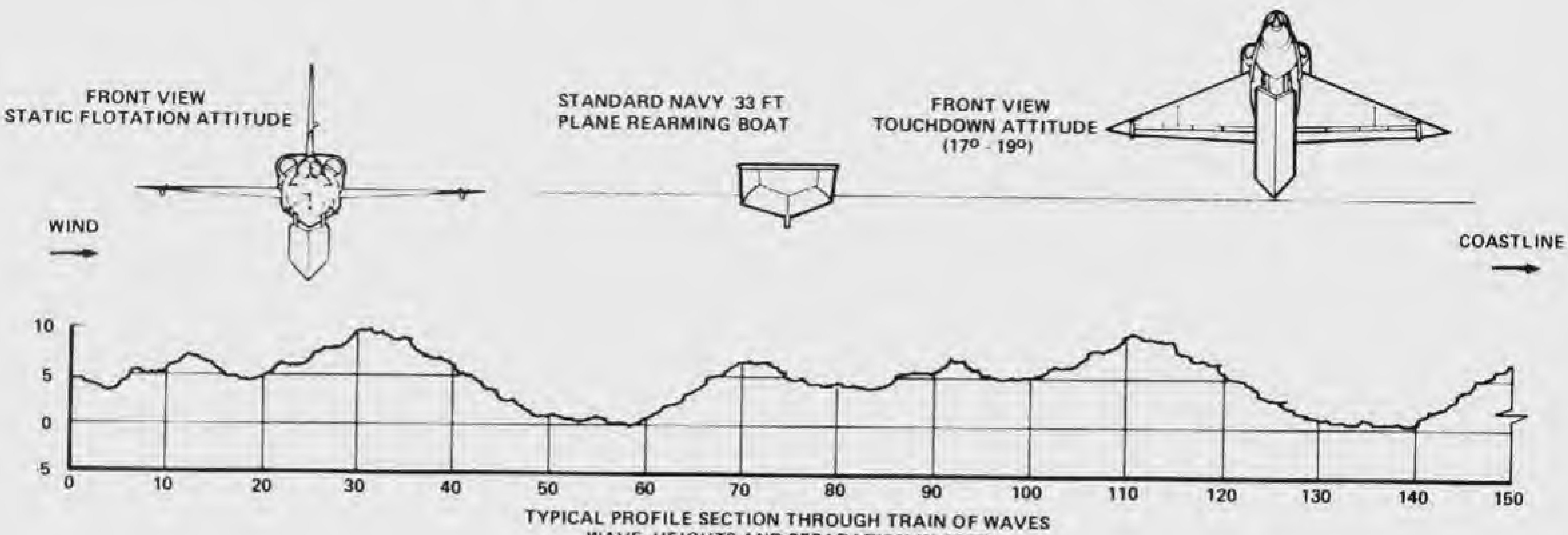
I used another technique to protect the engines from salt water ingestion especially when landing crosswind. I would advance the power as the aircraft started to settle into the water during landing run-out. This slowed ski submergence and suppressed resulting crosswind spray from entering the engines. I used the same technique when starting a crosswind take-off run. I would turn into the wind for ski unporting then turn to the desired take-off heading. These techniques greatly reduced spray into the engines.

During the program I conducted a series of water maneuvering or turning tests from low speeds at engine idle to lift-off speeds. The water rudders were only used at speeds below ski emergence or up to about eight knots.

Another interesting test I conducted was to verify the ten degree "V" deadrise design of the ski bottom. The objective was to simulate steeper deadrise by adding a small keel on the bottom center line of the ski. The

Dramatic view of the XF2Y-1 single-ski configured aircraft touching down at 120 knots. The ski oleos are fully extended for landing and lift-off. The high nose up attitude required for touch-down and lift-off creates the beautiful water roach at this speed.

U.S. NAVY XF2Y-1 SEADART BU NO. 137634



TYPICAL PROFILE SECTION THROUGH TRAIN OF WAVES
WAVE HEIGHTS AND SEPARATION IN FEET

added keel was about eight inches high, twenty four inches long, and located about four feet from the aft end of the ski. My first and only test of the "keel" proved quickly that the addition was unacceptable and dangerous. When maneuvering in the water at speeds above twenty to thirty knots it caused the aircraft to roll to the outside of the turn. The higher the speed the more severe the roll causing possible "dig in" or submerging of the outside wing tip. This could result in aircraft roll over or capsizing. The keel was quickly removed after just one test.

A seaplane "water loop" maneuver occurs when a wing tip float digs or drags in the water causing the aircraft to turn uncontrollably in the direction of the low wing. The SeaDart with the single-ski could not "water loop" in the normal seaplane manner. This was because the low wing tip on the inside of the turn was always running at a positive trim angle to the water. The extreme aft position of the delta wing tip contributed to this positive lifting in the water even if submerged.

The SeaDart program provided me with what I considered then, and still do, the rare opportunity to be testing both the XF2Y-1 single-ski aircraft and the YF2Y-1 twin-ski, number three SeaDart during the same time period. Several times I tested both aircraft on the same day including open sea tests. Often I tested each aircraft on consecutive days. My simultaneous testing of both aircraft occurred during the period of February through April of 1955. On 28 April 1955, I conducted the last test on any Twin-ski SeaDart, the number three aircraft. I continued to test the single-ski aircraft for another nine months.

Take-off tests were also conducted with JATO (jet assisted take-off, later termed rocket assisted take-off or RATO) bottles rated at one thousand pounds thrust each. These were attached to the under surface of the wing, two on each side. I made these tests on both aircraft in San Diego Bay and with the YF2Y-1 in the open sea. The bottles were fired in a sequence with one on each side being fired first, followed by the last two. After an arming switch was activated on the left console, the bottles were fired by a plunger switch located forward of the full throttle handles AB position.

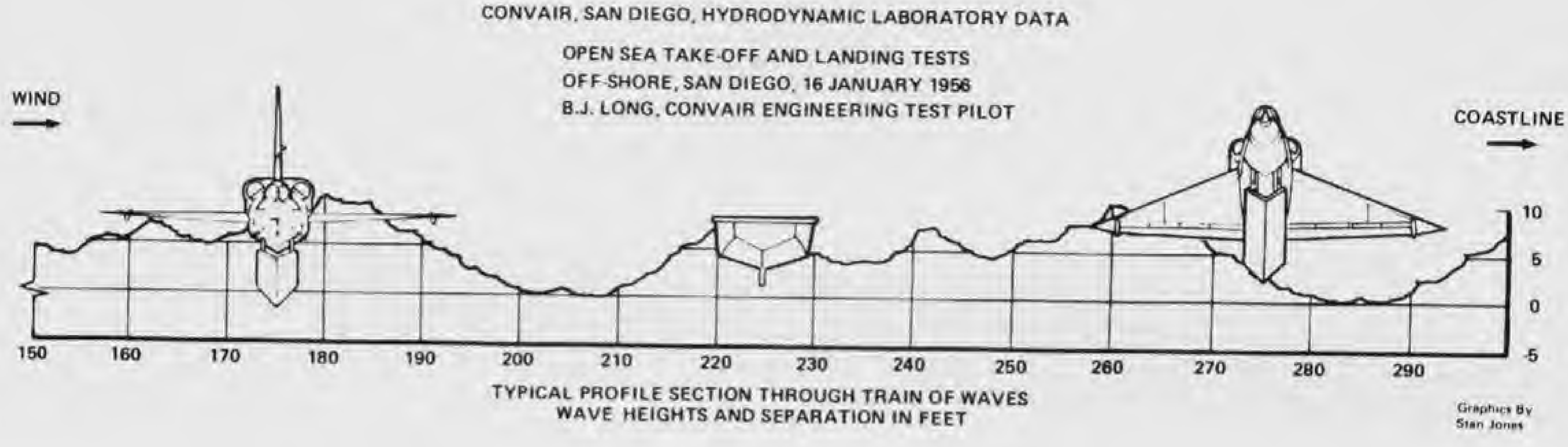
I was the only pilot to test the JATO installation on either aircraft. I would fire the first two bottles at about twenty to thirty knots and the last two at about sixty to seventy knots. The additional two thousand pounds of thrust during each firing period sure made for a shorter take-off run. On one test with JATO, the last two bottles did not fire and although the bottles could be jettisoned, it was not required for safety sake.

Except in very calm open sea conditions, it is an accepted practice for seaplanes to take-off and land parallel to the surface ground swells and major wave patterns. Surface winds are usually forty five to ninety degrees relative to the major wave patterns. Wind waves can be superimposed on top of the basic surface conditions. This was the procedure for SeaDart open sea tests on both aircraft. It is dangerous to impossible to operate a seaplane in rough sea conditions with take-offs and landings into the major swell and wave patterns just to accommodate an "into the wind" operation. The old axiom applies, "there is no such thing as a seaplane, there are only water based aircraft".

On 16 January 1956 I conducted the final flight and test on the XF2Y-1 single-ski SeaDart. The purpose of this test was to demonstrate the upper limit of rough open sea conditions for operating this aircraft. As for all SeaDart open sea tests, the home base for beginning the test was the Convair seaplane ramp on San Diego Bay.

My escort and chase aircraft was our Navy AD-5 Skyraider piloted by my good friend and engineering test pilot "Lou" Hoffmam. Our SeaDart

SINGLE SKI CONFIGURATION



project flight test engineer and also my good friend "Gene" Wigham was in the right seat with the Convair photographers in the large aft compartment.

Several Navy surface vessels including a barge type floating crane were already on site. A Navy helicopter with a frogman aboard was overhead for rescue purposes. The crane barge was also staffed with Convair hydrodynamic engineers, technicians, photographers and additional frogmen. They had deployed wave guides to record sea conditions obtaining accurate data during the entire test. They also deployed a smoke float to verify surface winds which were forty five degrees to the major wave and swell patterns.

Hoffman and Wigham had surveyed the landing site from the AD-5 as I waited on the ramp in the cockpit of the XF2Y-1 for an OK to start the operation. Wingham was very concerned about the heavy sea condition. He had been on the entire SeaDart test program and was thoroughly knowledgable about test operations and sea conditions. I finally overrode his concerns and started the test. I then flew the aircraft to a predetermined position several miles off shore and south of Point Loma.

The take-off and flight to the open sea test site was uneventful as the AD-5 flew chase with me. Being an old seaplane pilot I understood the sea and wind condition and knew this would be a real limiting test for the aircraft and me physically, and indeed it was.

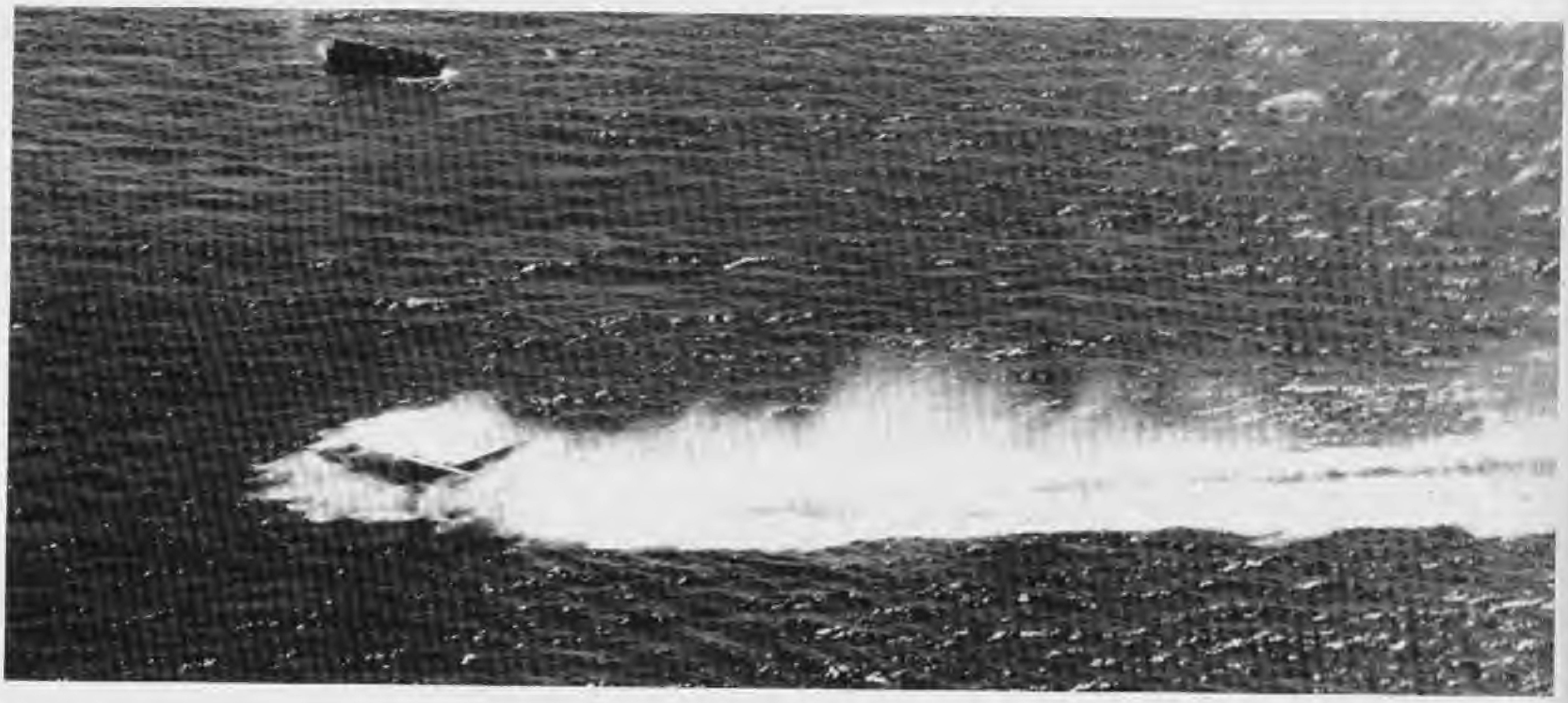
The landing heading and touch down point were of my choice with the waves varying from six to ten feet in height with a separation of fifty to a hundred feet. Small one to two foot waves were superimposed on the major wave patterns. A few waves measured twelve feet in height just prior to landing. This sea condition approached a rating of Seastate Five. I made my landings and take-offs parallel to the major wave patterns with the fifteen to twenty knot wind line about forty five degrees to the right of the aircraft heading.

Deceleration after touch-down at one hundred and twenty knots was rapid. The vertical and lateral motions experienced in the cockpit were severe. My helmet struck the "V" windscreen with such impacts in lateral motion that I tasted what I thought was blood. After all forward motion was stopped I removed my oxygen mask and realized that the impacts had forced mucous from my sinuses into my mouth.

Take-off bordered on the catastrophic. I over-rotated prematurely because of heavy pitching motions which made it appear that I might "trip" or dive into the heavy sea condition. This nose-high attitude kept me from simulating a torpedo but it also delayed my acceleration such that I kept ricocheting off the tops of waves. The resulting impacts experienced in the cockpit were intolerable. I was dazed and stunned. Aircraft test instrumentation recorded one vertical impact of 8.5 "G"s at a very high rate of acceleration.

Finally, after a forty one second take-off run and the last separation, Lou Hoffman in the AD-5, yelled for me to come out of afterburner so he could stay with me. The return flight and landing that followed were routine.This open sea test was the last flight or actual lift-off and landing for any SeaDart.

All SeaDart aircraft had only one thousand gallons (6,500 lbs) of fuel, thus all tests were very short in duration. Test time was logged from starting down the seaplane ramp to return up the ramp.The most time I ever logged on either aircraft was about fifty-five minutes. This included considerable time at low power settings in the water. My average test time was thirty to thirty-five minutes. The final flight test in the XF2Y-1 single-ski aircraft was only twenty-five minutes, but what a twenty-five minute



period that was.

The life of a test pilot has been described as "hours and hours of boredom punctuated by moments of stark terror". Well, I never experienced that level of anxiety testing these aircraft; however I had a few very interesting moments. On one flight to the open sea test area and soon after take-off, I experienced an abrupt deceleration in aircraft airspeed. I thought I was having a double engine failure, looking at the decreasing TPT gauges. Noticing the AC power red warning light on the right console, I switched to the alternate gernerator and restored normal thrust to both engines. The AC power failure had caused loss of the engine electronic control system and a transfer to engine mechanical control for safety purposes.

During a bay taxi test, I observed the right engine fire warning light. I reduced power, slowed to idle water speed, and transmitted to our boats and the ramp asking if they could see any sign of fire. They advised negative and I continued the test. The fire warning system was subject to false warnings because of salt corrosion. Upon my return to the ramp the problem was very obvious. Two exhaust nozzle leaves at the top of the right engine were missing. This allowed exhaust flames to be directed vertically, burning a hole clear through the top aft portion of the engine nacelle.

On another occasion during lift-off and touch-down runs in the bay, the aircraft felt very heavy and it really didn't want to fly at one hundred and twenty five knots. I received a transmission to return to the ramp immediately. Upon exiting the aircraft I observed multiple streams of water coming from the bottom of the hull. The hull had water tight compartments to insure flotation even with penetration in one or more compartments. One of the ramp crew had forgotten to replace the drain plugs on the compartments after his inspection. When I lifted-off water was streaming from all the holes and he immediately realized that the plugs were in his pocket. It was estimated that I made the take-off with over one ton of salt water in the compartments.

Convair's maintenance of these experimental water based aircraft was superb considering the unique aircraft design with the ski oleo concept, new engines and subsystems that were operated in a very hostile environment consisting of constant salt water exposure and very severe structural loads.

Airframe and cockpit vibration was not present in the XF2Y-1 single-ski configured SeaDart as it was in the YF2Y-1 twin-ski number three aircraft. Pounding loads were experienced as in all seaplanes, the rougher the water or sea condition the more severe the pounding. I considered the pilot's ride in the single-ski aircraft to be acceptable for a high performance water based aircraft. Engines of greater thrust would have enhanced hydrodynamic performance dramatically.

In a rough water landing deceleration was rapid due to the heavy sea spray and wave chop.

On 31 October 1955, I had demonstrated the XF2Y-1 single-ski aircraft to RADM James S. Russell, Chief of Navy Bureau of Aeronautics. He was a brilliant officer with an outstanding record in Naval Aviation. He was warm and friendly and climbed the service ladder in his blue uniform, white cap and grey gloves, where he helped strap me into the seat. After the demonstration and the group greeting, he requested a private consultation. We moved away from the group and he asked me what I thought of the single-ski SeaDart. I responded by suggesting to him that if the aerodynamic refinements of the YF-102A were combined with a fully retractable single-ski and engines of greater thrust were provided, then the Navy would have an outstanding supersonic operational water based fighter.

The XF2Y-1 large single-ski test program was considered completed with FTO-245, the 16 January 1956 open sea test. This was my 98th test operation in SeaDart aircraft. It was the final flight of any SeaDart. My return landing in San Diego Bay was the final landing of any SeaDart and my 187th landing. The aircraft was then placed in storage with the remaining three YF2Y-1 SeaDarts.

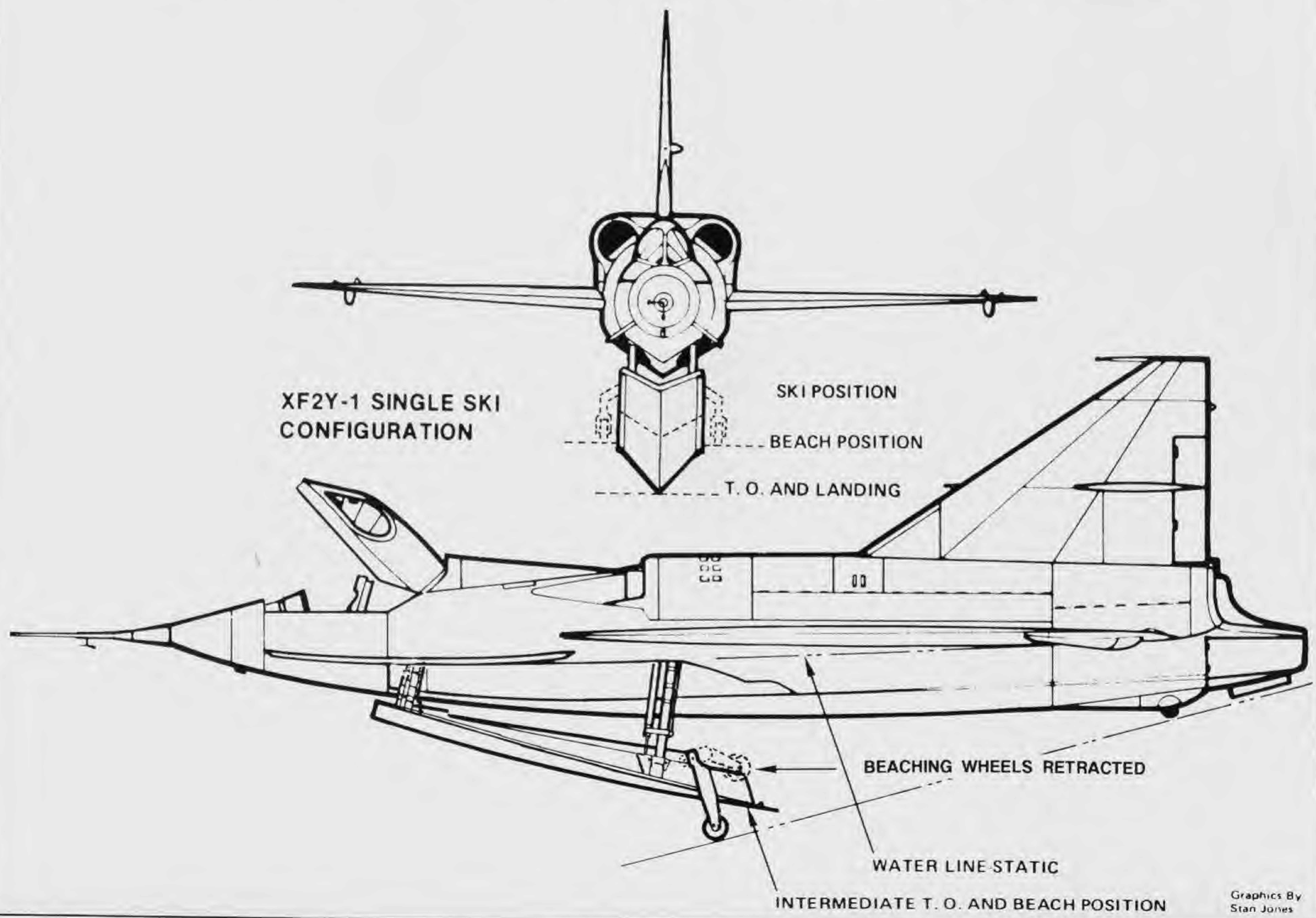
SINGLE-SKI OPEN SEA LANDING TESTS

XF2Y-1 with AD-5 chase plane conducts an open sea landing in moderate sea conditions at a 120 knot touch-down speed.

Single-ski aircraft enroute to the Convair seaplane ramp in San Diego Bay after open sea tests.

The single-ski aircraft taxies up the Convair seaplane ramp, note the water rudder extension on the bottom of the speed brakes.

SEADART NUMBER ONE, XF2Y-1 Bu No 137634 (LARGE SINGLE-SKI)



SEADART NUMBER THREE, YF2Y-1 Bu No 135763 (TWIN-SKI)

Early on the morning of 4 March 1955, I went to the office of E. D. "Sam" Shannon, Chief of Engineering Flight Test, to advise him of my plans that day for the first test of the newest SeaDart. YF2Y-1 (135763), the number three aircraft, was equipped with the best and final twin-ski configuration. Shannon's age was 46 and to me being 31, he seemed much older. Shannon was a legendary test pilot and an early "Honorary Fellow" in the Society of Experimental Test Pilots along with other greats such as General "Jimmy" Doolittle, Mr. Howard Hughes, Mr. Charles Lindbergh, and others.

Shannon was an impressively tall and comely gentleman with the mild southern mannerisms of a Gary Cooper type movie star. Shannon was known as "Sam" but I always addressed him as Mr. Shannon. He was affectionately referred to as "Silent Sam" because he always had little to say in soft, slow, but very meaningful ways. I entered his office after requesting permission from his

Clearly depicted in this front view with test pilot B. J. Long are the massive "footprints" of the skis on the YF2Y-1 number three SeaDart. Note the curvature of the ski outboard edges, the broad leading edges and taper towards the aft end of the skis. Also note the elevon actuator fairings near the wing tip

gracious lady secretary, Lucille Metcalf. Shannon was leaning back in his chair with his feet on his desk, as often observed.

I started my message with "Mr. Shannon" and advised him in the few words, "I am taking the new aircraft out today for its first test". He responded, "Well sit down Billy Jack and tell me what you are going to do". Sitting on the edge of my chair, I quickly reviewed the testplan. I finished, rose from my chair and said "That's it Mr. Shannon". He responded with the greatest and most meaningful comment made to me in my life, even to the time of writing this story. "Sam" said only, "Well, be careful, Billy Jack". What a vote of confidence! I thanked him and departed. I will be forever grateful to Shannon for his confidence in me.

At this point in time, I had already conducted eleven test operations in the XF2Y-1 single-ski aircraft with Shannon having made only one test in the aircraft since I had made my first SeaDart test.

Shannon never came to my preflight or postflight meetings; however, I always gave him a short verbal report in private after each test which was in addition to my formal written report to engineering and executive management. Shannon never challenged me regarding my test plan or test results. What a great boss! I guess I must have been doing OK. I should add, however, he did watch me from a point of land beyond our seaplane ramp on my first tests in both aircraft. He was by himself and never mentioned it.

This number three SeaDart was the nearest of the three aircraft to a production model with no special test instrumentation incorporated. The aircraft was painted allover Navy blue except for the star and bar insignias and white stencil markings including "NAVY". It was the second twin-ski aircraft with beaching wheels as an integral part of the skis. This aircraft also had twin Westinghouse J-46 afterburning engines, the same as those retrofitted to the XF2Y-1 when the single-ski was installed. Since I had done most of the testing on the single-ski aircraft I was familiar with engine operation and characteristics.

For water operation the bottom plan form or "foot print" of the ski afterbodies were the same as the best design finally derived on the number two aircraft, which did not have wheels. The afterbodies' "foot print" were tapered and pointed. The wheels were mounted flat on the top surface of the ski afterbodies with a slight tread overhang on the inside of the bottom planing surface. The afterbodies rotated 90 degrees just aft of the skis main oleo struts. On the ramp with the wheels "extended" the bottom afterbodies faced outward and appeared as spurs.

After water entry and aircraft floatation, the ski afterbodies were rotated or retracted inward at the bottom to a 90 degree position. This was accomplished by the pilot actuating a "wheel retraction" switch in the cockpit which in turn hydraulically rotated the afterbodies. The wheels were "extended" or rotated to the beach position when approaching the

The YF2Y-1 number three aircraft departing the seaplane ramp at idle thrust (3 to 5 knots). Note the "water line" on the aircraft in this almost static floatation condition and the spray rails.

seaplane ramp.

The duration of this first test (FTO-1) was 25 minutes during which I made several taxi tests demonstrating ski unporting, ski oleo position changes versus water speed, and directional maneuvering at various water speeds. I then conducted two lift-off and touchdown runs without incident. Speeds for all three maneuvers were the same as the single-ski aircraft.

With this my first test of any twin-ski configured SeaDart, I experienced the inherent cockpit and airframe vibration generated by the twin-skis traversing the wave patterns. Even with small waves in the bay it was noticable as lift-off speed was approached. It was obvious this condition was caused by the skis flexing between the front and back attachment points and ski oleo stiffness.

Even more obvious was that the twin-ski SeaDart required much less pilot technique to operate the aircraft at all water speeds as compared to the single-ski aircraft. Laterally the aircraft was hydrodynamically stable because of the twin-skis, thus no banking or wing tip dragging could be used. It was equally apparent to me that a pilot with little or no seaplane experience could operate and adapt to the twin-ski SeaDart much easier than the single-ski model.

Our SeaDart and Tradewind turboprop flying boat seaplane area was on the northern half of San Diego Bay opposite NAS North Island. The Coast Guard station just east of our Convair seaplane ramp also used our area for their flying boats if necessary. Halfway across the bay was a line of large Navy buoys for tieing up submarines and their tenders. The line of buoys ran east and west and in effect separated the bay. The southern half adjacent to the NAS was used by Navy Martin P5M flying boats near their ramps. Large ships used the south side for bay ingress and egress.

The prevailing surface winds in our bay area were generally from the west. Occasionally we had winds from the south which constituted a cross wind take-off and landing condition. Very seldom we experienced east winds from the desert regions.

Early-on in a subsequent test in this new twin-ski aircraft, I experienced uncontrollable downwind turning of the aircraft during a strong cross wind take-off run. The faster the water speed while accelerating to lift-off speed, the more the aircraft turned downwind. I aborted the run otherwise I would have impacted land while still in the water or soon after being airborne. By that point my take-off course had been altered 45 degrees or more.

I cannot rationalize why this hydrodynamic directional stability and control problem had not been experienced on the earlier twin-ski configurations. I can only surmise that

Rear view of twin-ski equipped 135763 leaving the ramp at idle power. Note the water line in relation to the wing. The white wing and tail stenciling shows off well and the auxiliary air intake doors are open.

the shape of the new ski afterbodies with the wheels being flat on the top made the difference.

The hydrodynamic directional stability forces far exceeded the aircraft's aerodynamic directional forces while in contact with the water, thus the ever increasing downwind turning. This is a classic comparison of water dynamic pressure ("q") with aerodynamic pressures at any velocity.

Our Convair San Diego Hydrodynamic Engineering Group quickly solved the problem. The solution was to de-stabilize the hydrodynamic directional stability of this twin-ski configuration. This was accomplished by adding small "skegs" to the bottom surface of the ski afterbodies. They were "L" shaped extruded angles fastened to the aft sections that rotated with the wheels and also forward on the main portion of the skis extending to a position below the ski main oleos. The results were great. In the next cross wind test, I had no difficulty in maintaining desired take-off heading through lift-off, thus solving that problem.

In the next 35 calender days from my first test in this number three SeaDart, I concluded the test evaluation of the final twin-ski configuration with FTO-17 on 28 April 1955. During that period three Navy test pilots from Naval Air Test Center, Patuxent River, Maryland, conducted one test each with the aircraft in addition to my seventeen tests. They also conducted one test each on the XF2Y-1 single-ski aircraft during the same period.

The Navy evaluation pilots preferred the general hydrodynamic handling qualities of the twin-ski aircraft over the single-ski aircraft. They strongly concurred that the cockpit and airframe vibration in the twin-ski aircraft was unacceptable. Although the Navy pilots had some flying boat experience, they felt more at ease with the twin-ski configuration. It was my opinion that they did not have sufficient time to learn and appreciate the single-ski handling qualities.

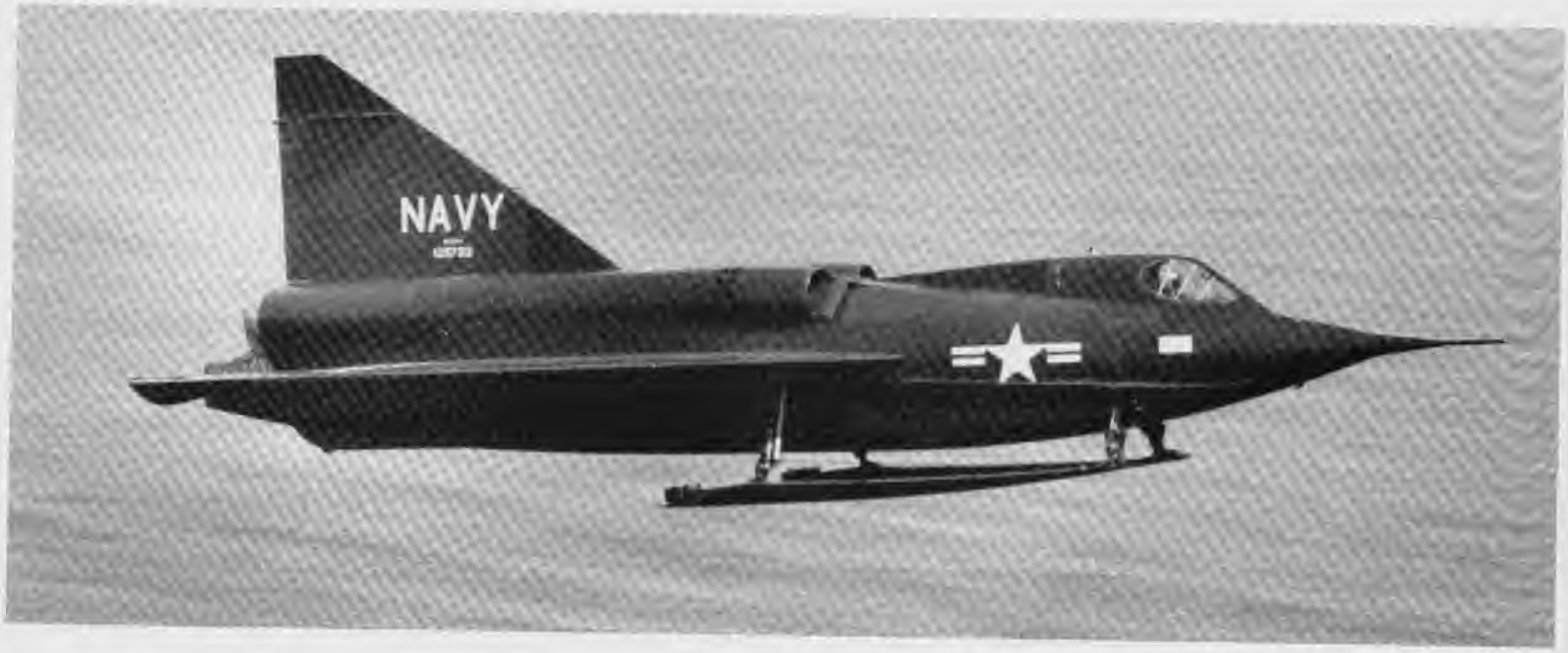
For the the twin-ski aircraft, the Navy pilots requested an airspeed pressure sensing switch to be installed that automatically fully extended the ski oleos at about 50 knots during the take-off run. They felt it was a distraction for the pilot to actuate the cockpit switch during the take-off run. It was installed overnight and worked fine. The test team from Pax River was satisfied with the arrangement. However, I did not like the automatic switching and had it disconnected for the remainder of my tests on this aircraft. Varying water and wind surface conditions dictated slightly different speeds for oleo full extension during take-off runs.

On 18 March 1955 I conducted a JATO demonstration (FTO-6) in the bay. The water was relatively calm and take-off time and distance were greatly improved with the JATO bottles of 1,000 pounds thrust each. Cockpit vibration exposure was significantly reduced because of the reduced time and distance to lift-off. The test was continued with a flight out of the bay, around North Island, and return!

The very next twin-ski test

The three Pax River test pilots pose in front of 135763 during their evaluation at Convair. L to R; LCDR "Ernie" Horrell, CDR "Cordie" Weart , and CDR Fretwell.

B. J. Long lands the YF2Y-1 in San Diego Bay after its first extended flight (FTO-4) on 15 March 1955. The Point Loma peninsula is in the background.



(FTO-7) on 21 March 1955, I demonstrated the first open sea landing and take-off with the new number three aircraft. It was also my first open sea operation in either of the SeaDart aircraft. The very next day, 22 March, I conducted two open sea tests with the XF2Y-1 single-ski aircraft plus a bay test in the YF2Y-1 (FTO-8). These were busy days. Within an eight day period from 21 March through 29 March 1955, I conducted a total of five open sea tests with the two aircraft. These tests gave me a really great opportunity to compare the open sea operating characteristics of SeaDart aircraft with the different ski configurations. Again the open sea tests were complex with all the Navy and Convair surface vessels, aircraft, and personnel supporting the operations.

During my second open sea test (FTO-10) in the twin-ski aircraft, I used the four JATO bottles for the open sea take-off after landing. As with a previous JATO demonstration, the bottles were fired two at a time. The added thrust sure made a great improvement in time and distance to lift-off and the quality of my ride in the cockpit.

I made all open sea landings and take-offs in a direction parallel to the major swell and wave patterns. This usually resulted in a cross wind condition of about 45 degrees from the right or left. I used all of the water handling techniques previously discussed in the XF2Y-1 single-ski section to supress water ingestion into the engines. They included power

YF2Y-1 enroute to open sea test (FTO-7). Skis are not yet fully extended for landing. Note "retracted" wheels atop ski afterbodies.

YF2Y-1, number 3 aircraft during take-off with four 1,000 pound JATO bottles firing. NAS North Island is in the background.

YF2Y-1 at 1,500 feet altitude prior to open sea landing off San Diego. Note JATO bottles, under right wing, used for open sea take-off. White caps are clearly visible on the ocean surface.

application at landing run-out to slow ski submergence and turning into the wind for ski unporting. The aircraft was then turned to the desired heading for take-off. These handling techniques proved highly successful for both aircraft.

My observations, which were verified by aircraft instrumentation data, that the worst water surface conditions for inducing extreme vibratory loads on the twin-ski airframe and the pilot were in the bay where there was a close-coupled wind wave chop pattern of about 24 inches in height. This water condition provided a constant "wash board" surface effect which excited the skis like a tuning fork. There were no major waves or swells to break the continuity of the pattern. Thus the vibration amplitude tended to increase. With lift-off the vibration would damp or cease instantly.

In the previously described bay test condition, the twin-ski SeaDart recorded vertical vibratory loads in the cockpit of plus and minus 5.5 "G"s at 15 to 17 cycles per second prior to lift-off. In this environment I experienced "shotgun" vision and my only facilities were pulling back on the stick and trying to break the throttles off in the afterburner position. Nothing in the cockpit was visible.

In the open sea, even with rougher water surface conditions than encountered in the bay, the vibratory loads were not as severe because of

YF2Y-1, number three SeaDart, returning home to San Diego bay after an open sea test (FTO-10) with four JATO bottles. The skis are not yet fully extended for landing.

YF2Y-1 (135763) open sea touchdown at 120 knots during relatively calm sea conditions.

the very irregular surface of the sea. Some heavy impacts were felt in the cockpit as would any seaplane in similar sea conditions; however, the pilot blinding vibratory loads were not experienced. The twin-ski aircraft would have been easier to handle in the open sea as compared to the single-ski configuration for pilots with little or no seaplane experience. Still the single-ski aircraft was far superior in the open sea and could be readily learned by land plane pilots with proper indoctrination.

I never accepted this best of the twin-ski configurations as being suitable for an operational aircraft. The pointed afterbodies of the skis did give penetration relief when traversing rough water but the flat planing surfaces of the ski bottoms, rather stiff ski oleo actions, and flexing of the ski midbodies all added up to an unacceptable ski design with respect to vibration and pounding loads. Hydrodynamic stability and control, however, were excellent. Take-off and landing airspeeds were the same for both twin and single-ski aircraft. Lift characteristics of the SeaDart delta wing were not impressive. The wing had a symmetrical airfoil with a mean aerodynamic thickness of only 3.83 percent. The lift-over-drag ratio (L/D) was low at high angles of attack. Soon high performance aircraft wings were improved in lift characteristics by incorporating cambered airfoils as with the YF-102A. Delta wing aircraft do not incur the normal stall characteristics of straight or swept wing aircraft configurations such as airframe buffet, rolling tendencies, and general loss of control. The delta aircraft instead commences a high rate of sink condition with no stall warning while pitch, yaw, and roll control are still maintained. This is a simple explanation to a complex aerodynamic and flight characteristics subject. For the inexperienced or improperly trained pilot this delta wing flight characteristic can be fatal.

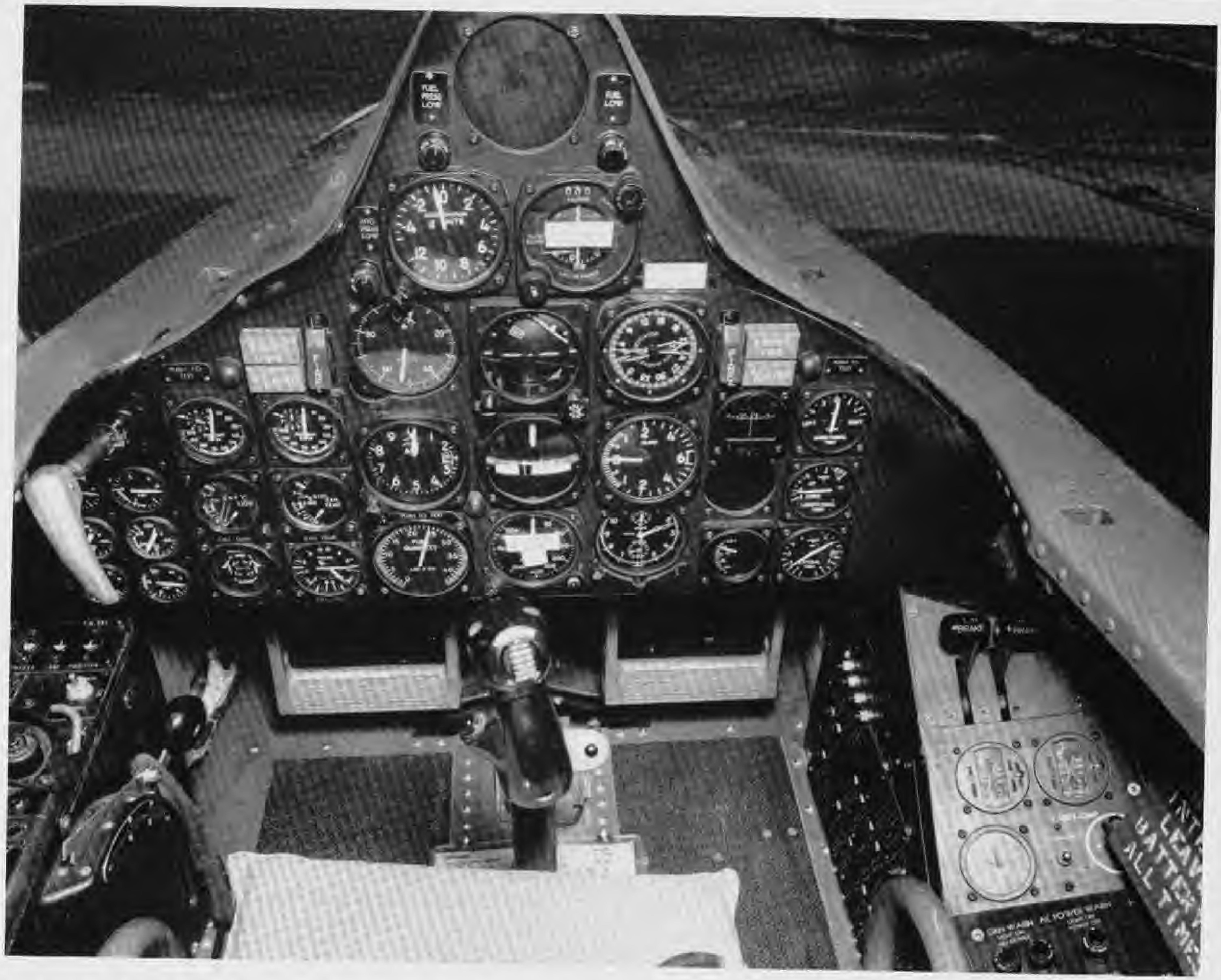
The YF2Y-1 twin-ski test evaluation was concluded on 28 April 1955 with my final test (FTO-17) which included four take-offs and landings. Even though I continued to test the XF2Y-1 single-ski aircraft for an additional nine months, I missed the thrill of testing the twin-ski SeaDart water based jet fighter type aircraft. The YF2Y-1 twin-ski number three SeaDart was placed in storage and never tested again.

YF2Y-1 open sea landing. Crosswind from the left is clearly visible from smoke float and wave patterns. Barge with crane stand by for emergency salvage operations.

YF2Y-1 twin-ski open sea take-off creates heavy spray which hides most of the tail. At right the helicopter photographs the event.

Above, B. J. Long sets the SeaDart down in the crowded confines of San Diego Bay after completing open sea tests while being monitored by the AD-5 chase plane. Below, B. J. idles up to the ramp after a test operation. This view shows off the flat black anti-glare panel and the bulge that was added to the forward fuselage above the forward oleo struts to incorporate extra shock absorbing capacity to reduce the pounding vibrations.

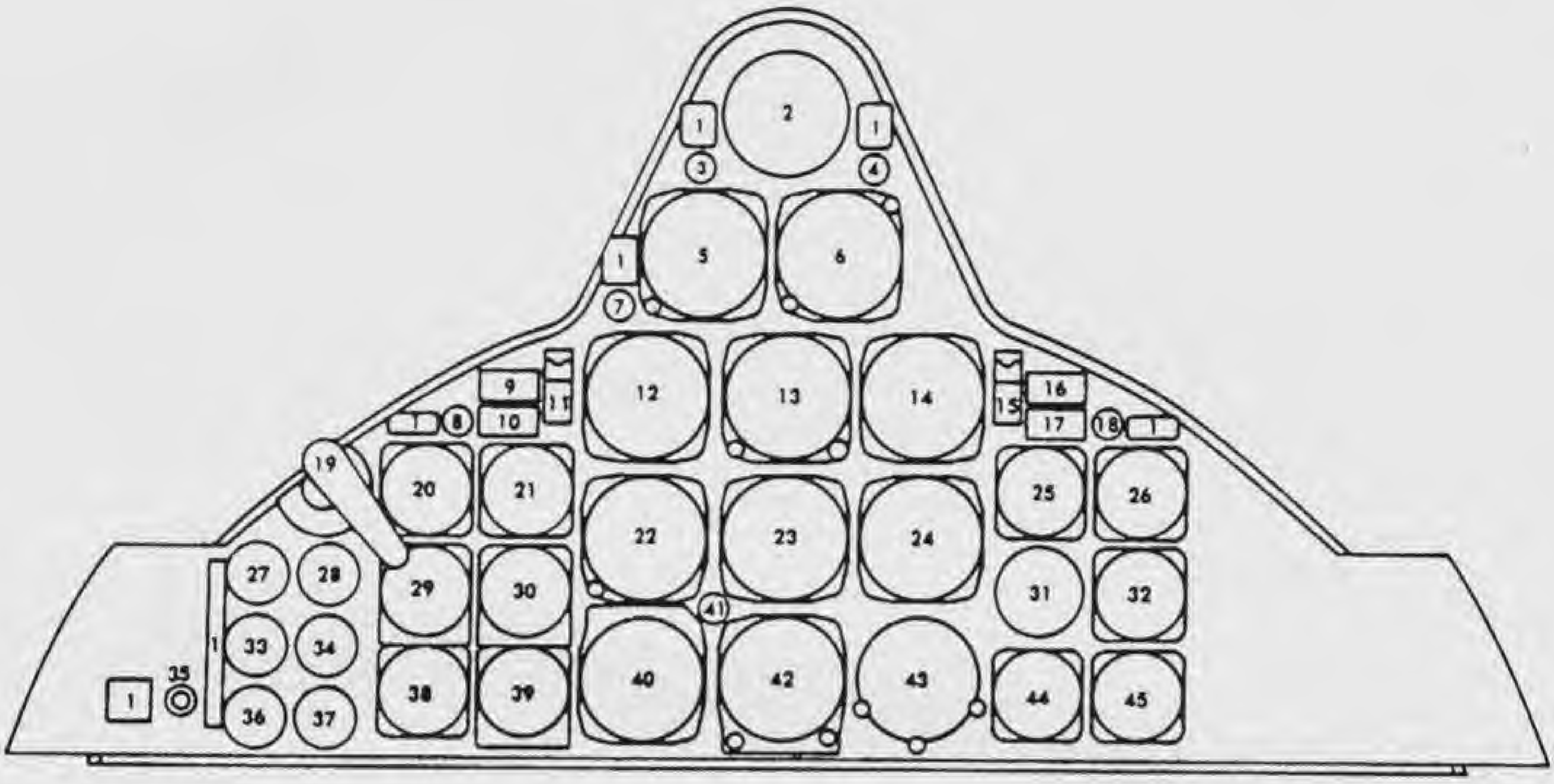
YF2Y-1 135763 COCKPIT DETAILS, INSTRUMENT PANEL



In June 1957 the retired SeaDart was transported to NAS Los Alamitos as a display aircraft at the National Model Airplane Contest, B. J. Long attended and briefed the public and signed autographs. (via Clay Jansson)

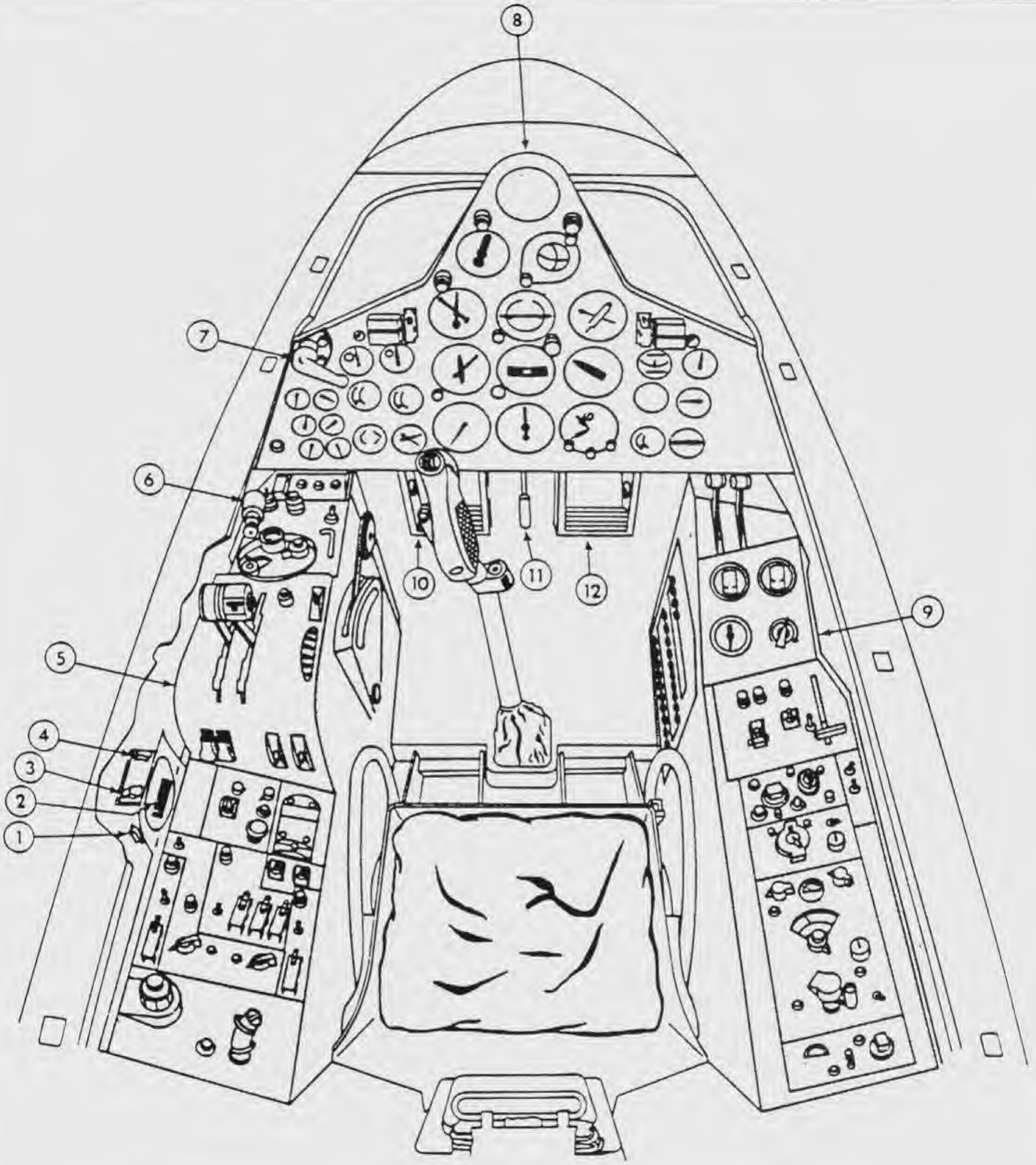
YF2Y-1 135763 COCKPIT DETAILS, CANOPY AND EJECTION SEAT

YF2Y-1 135763 COCKPIT DETAILS, INSTRUMENT PANEL LEGEND



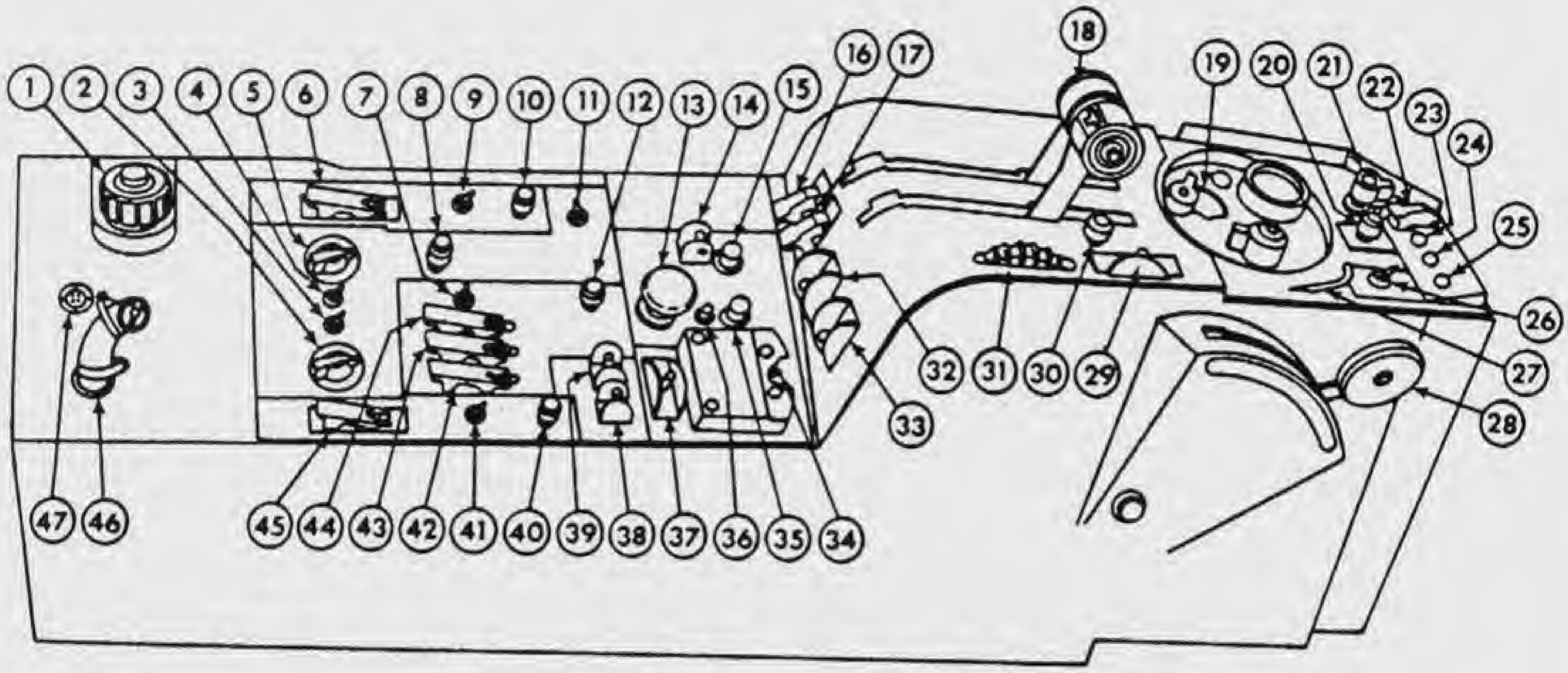
1. PLACARD
2. SPACE PROVISION
3. FUEL PRESSURE LOW WARNING LIGHT
4. FUEL QUANTITY LOW WARNING LIGHT
5. ACCELEROMETER
6. COURSE INDICATOR (ID-249)
7. HYDRAULIC PRESSURE LOW WARNING LIGHT
8. ENGINE AND AFTERBURNER FIRE CIRCUITS "PUSH TO TEST" SWITCH (LEFT NACELLE)
9. LEFT ENGINE FIRE WARNING LIGHT
10. LEFT AFTERBURNER FIRE WARNING LIGHT
11. LEFT NACELLE FIRE EXTINGUISHER DISCHARGE SWITCH
12. AIRSPEED INDICATOR
13. GYRO HORIZON INDICATOR
14. RADIO MAGNETIC INDICATOR
15. RIGHT NACELLE FIRE EXTINGUISHER DISCHARGE SWITCH
16. RIGHT ENGINE FIRE WARNING LIGHT
17. RIGHT AFTERBURNER FIRE WARNING LIGHT
18. ENGINE AND AFTERBURNER FIRE CIRCUITS "PUSH TO TEST" SWITCH (RIGHT NACELLE)
19. CANOPY LOCKING HANDLE
20. LEFT ENGINE TACHOMETER
21. RIGHT ENGINE TACHOMETER
22. ALTIMETER
23. TURN AND BANK
24. RATE OF CLIMB
25. MAGNETIC COMPASS
26. DIRECTIONAL TRIM GAGE
27. LEFT HYDRAULIC PRESSURE GAGE
28. RIGHT HYDRAULIC PRESSURE GAGE
29. LEFT ENGINE EXHAUST TEMPERATURE GAGE
30. RIGHT ENGINE EXHAUST TEMPERATURE GAGE
31. SPACE PROVISION
32. LONGITUDINAL TRIM GAGE
33. LEFT ENGINE OIL TEMPERATURE GAGE
34. RIGHT ENGINE OIL TEMPERATURE GAGE
35. WATER RUDDER INDICATOR
36. LEFT ENGINE OIL PRESSURE GAGE
37. RIGHT ENGINE OIL PRESSURE GAGE
38. NOZZLE POSITION INDICATOR
39. FUEL PRESSURE GAGE
40. FUEL QUANTITY GAGE
41. FUEL QUANTITY "PUSH TO TEST" SWITCH
42. RADIO ALTIMETER
43. CLOCK
44. FREE AIR TEMPERATURE GAGE
45. LATERAL TRIM GAGE

YF2Y-1 135763 COCKPIT DETAILS, COCKPIT LAYOUT



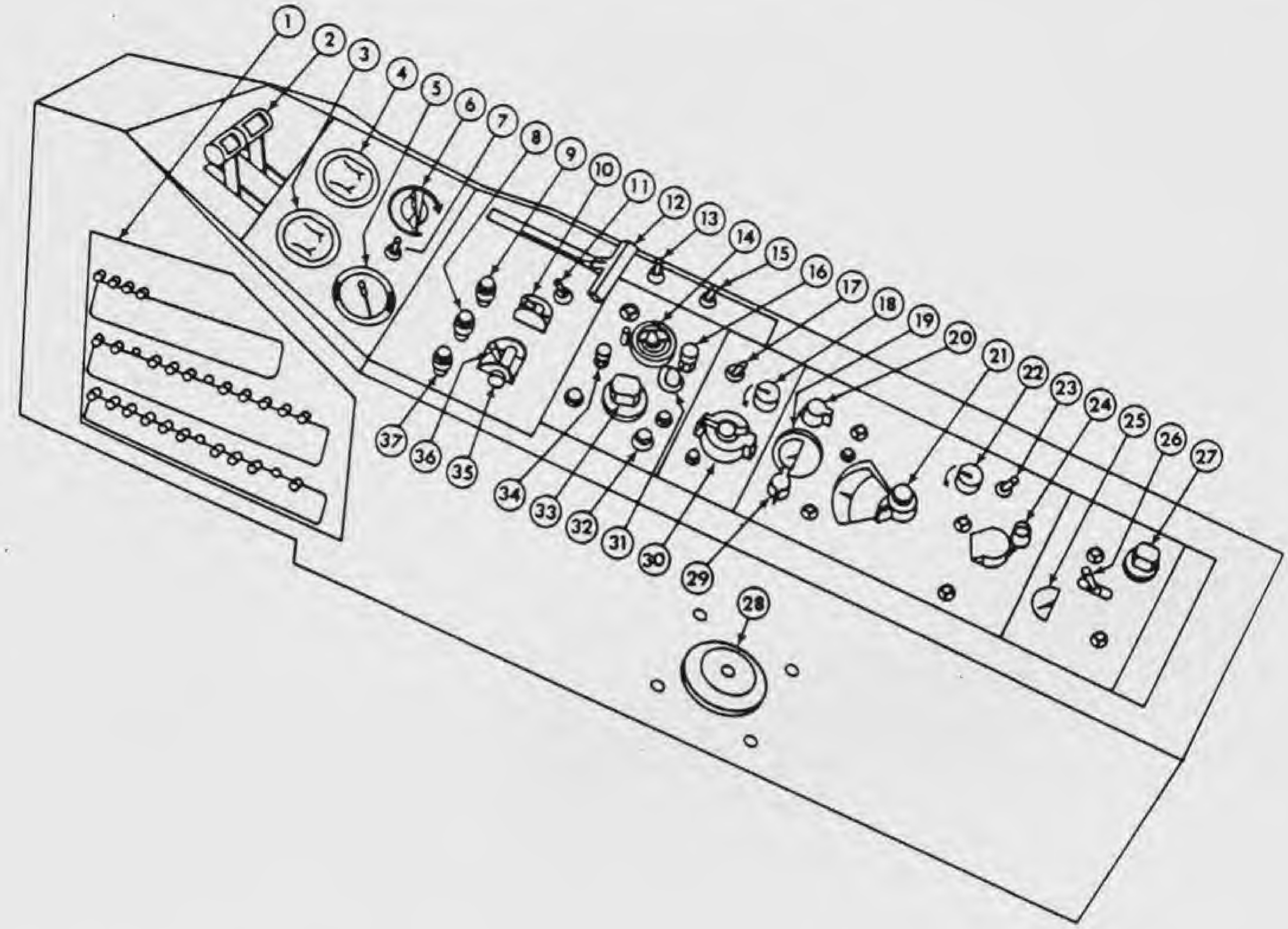
1. EMERGENCY SKIS EXTEND SWITCH
2. EMERGENCY SKIS EXTEND "T" HANDLE
3. JATO DROP SWITCH
4. JATO ARM SWITCH
5. LEFT CONSOLE
6. JATO FIRE SWITCH
7. CANOPY LOCKING HANDLE
8. INSTRUMENT PANEL
9. RIGHT CONSOLE
10. LEFT RUDDER PEDAL
11. RUDDER PEDAL ADJUST LEVER
12. RIGHT RUDDER PEDAL

YF2Y-1 135763 COCKPIT DETAILS, LEFT HAND PILOTS CONSOLE



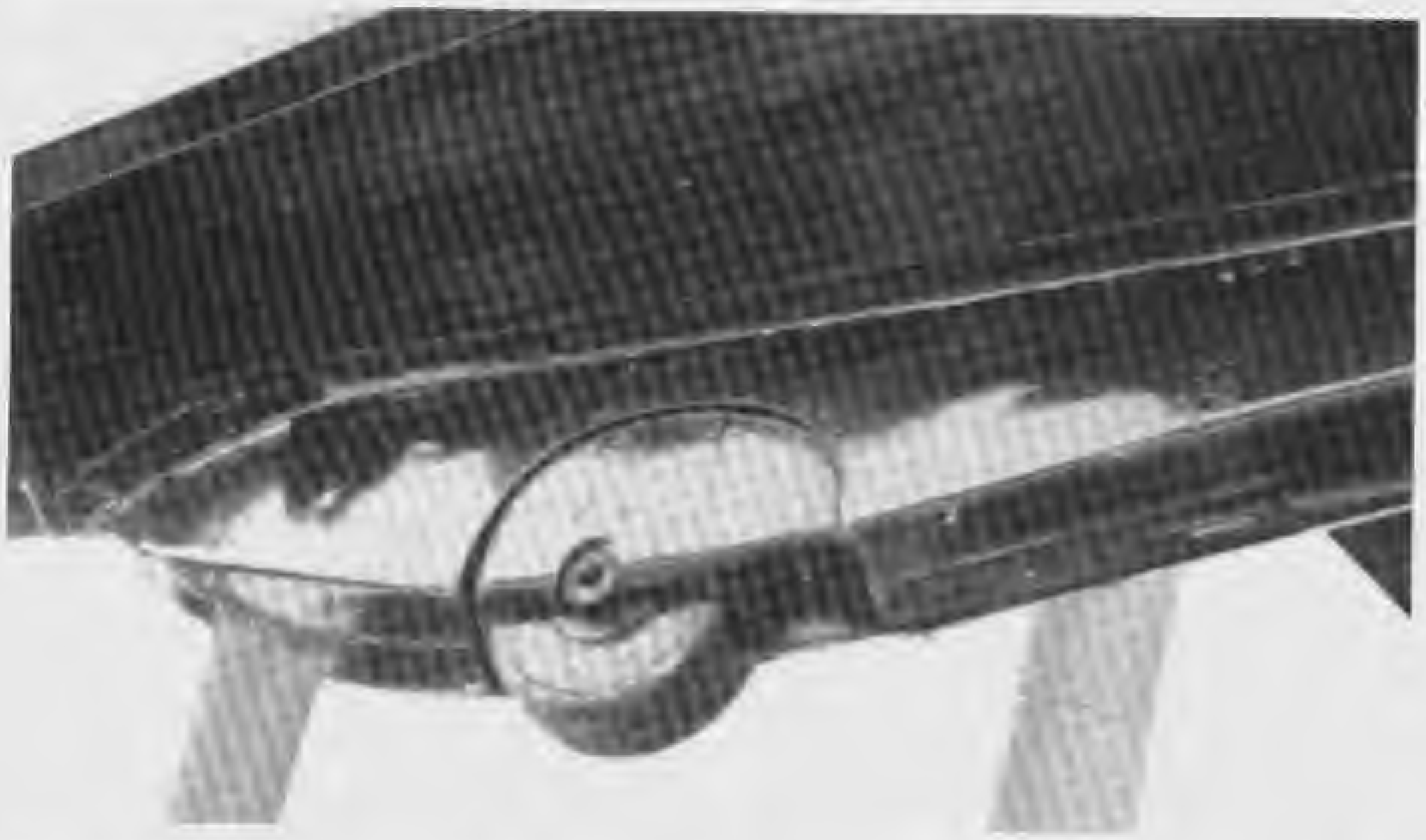
1. "G" SUIT CONTROL VALVE
2. RH EXHAUST NOZZLE CONTROL
3. RH TEMPERATURE TRIM CONTROL SWITCH
4. LH TEMPERATURE TRIM CONTROL SWITCH
5. LH EXHAUST NOZZLE CONTROL
6. LH FUEL VALVE SWITCH
7. AUXILIARY FUEL TANK TRANSFER SWITCH
8. TEMPERATURE TRIM CONTROL POWER WARNING LIGHT
9. LH ENGINE PRIMARY-EMERGENCY FUEL PUMP SWITCH
10. LH ENGINE PRIMARY-EMERGENCY FUEL PUMP WARNING LIGHT
11. PITOT HEAT SWITCH
12. AUXILIARY TANK EMPTY WARNING LIGHT
13. YAW ENGAGE LOCK-IN CONTROL
14. YAW CANCELLOR SWITCH
15. YAW CANCELLOR TIME CONSTANT CONTROL
16. LH ENGINE DUCT DOOR SWITCH
17. RH ENGINE DUCT DOOR SWITCH
18. LH AND RH THROTTLES
19. OXYGEN REGULATOR
20. STRUTS EXTENDED WARNING LIGHT
21. OXYGEN EMERGENCY CONTROL
22. TAXI WHEELS CONTROL SWITCH
23. TAXI WHEELS POSITION INDICATOR
24. LH SKI POSITION INDICATOR
25. RH SKI POSITION INDICATOR
26. SKI POSITION SELECTOR SWITCH (OLEO POSITION)
27. SKI POSITION TOGGLE LINKAGE ACTUATOR
28. SKIS UP-DOWN CONTROL LEVER
29. DIVE BRAKE EXTEND-RETRACT SWITCH
30. DIVE BRAKE EXTENDED WARNING LIGHT
31. POWER LEVER FRICTION CONTROL
32. LH ENGINE MASTER SWITCH
33. RH ENGINE MASTER SWITCH
34. RUDDER TRIM SWITCH
35. YAW CANCELLOR GAIN CONTROL
36. YAW ENGAGE LOCK-IN RELEASE BUTTON
37. LATERAL TRIM SWITCH
38. RH ENGINE START SWITCH
39. LH ENGINE START SWITCH
40. RH ENGINE PRIMARY-EMERGENCY FUEL PUMP WARNING LIGHT
41. RH ENGINE PRIMARY-EMERGENCY FUEL PUMP SWITCH
42. AFT RH FUEL TANK BOOSTER PUMP SWITCH
43. AFT LH FUEL TANK BOOSTER PUMP SWITCH
44. FORWARD FUEL TANK BOOSTER PUMP SWITCH
45. RH FUEL VALVE SWITCH
46. "G" SUIT CONNECTOR
47. HEADSET AND MICROPHONE CONNECTION

YF2Y-1 135763 COCKPIT DETAILS, RIGHT HAND PILOTS CONSOLE

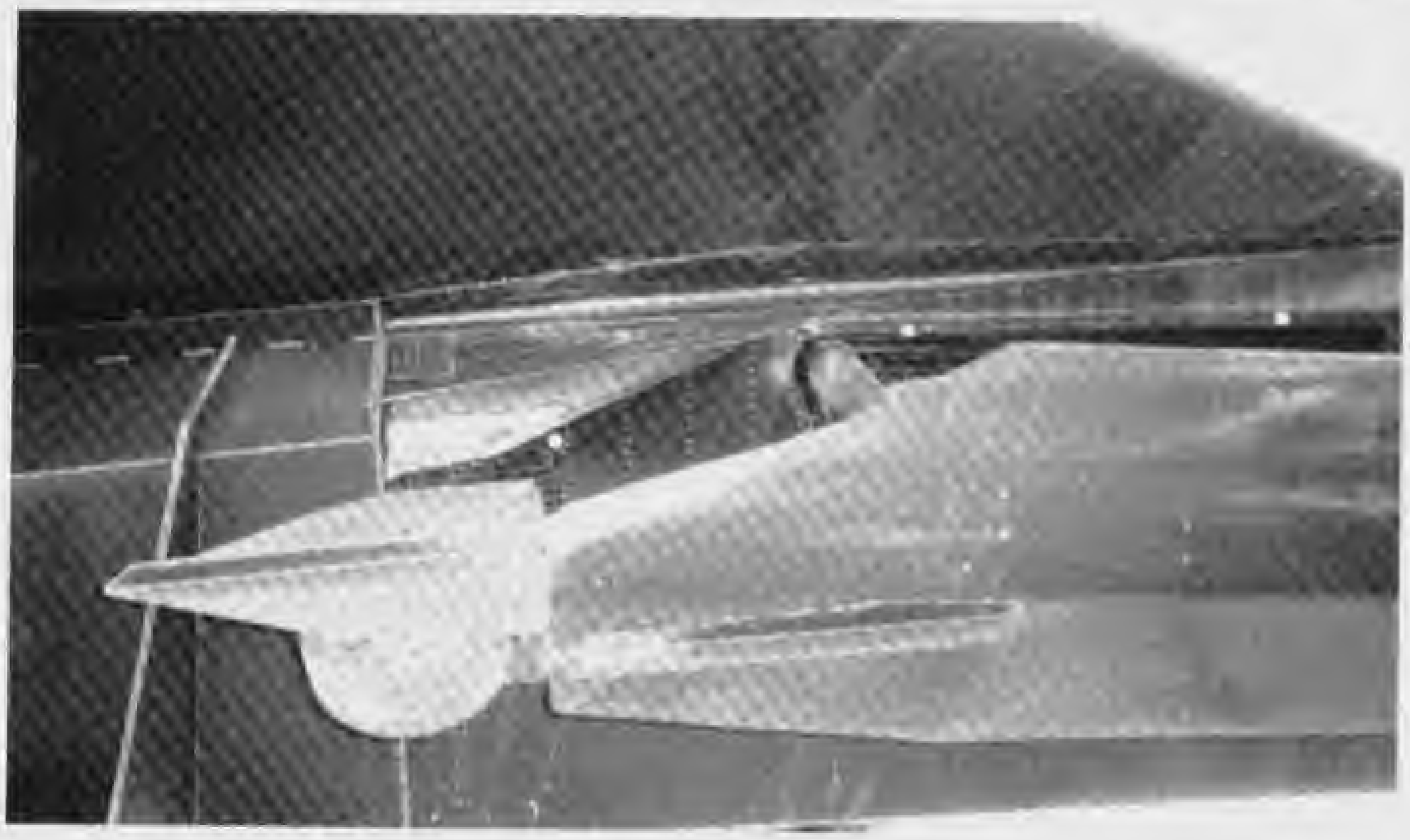


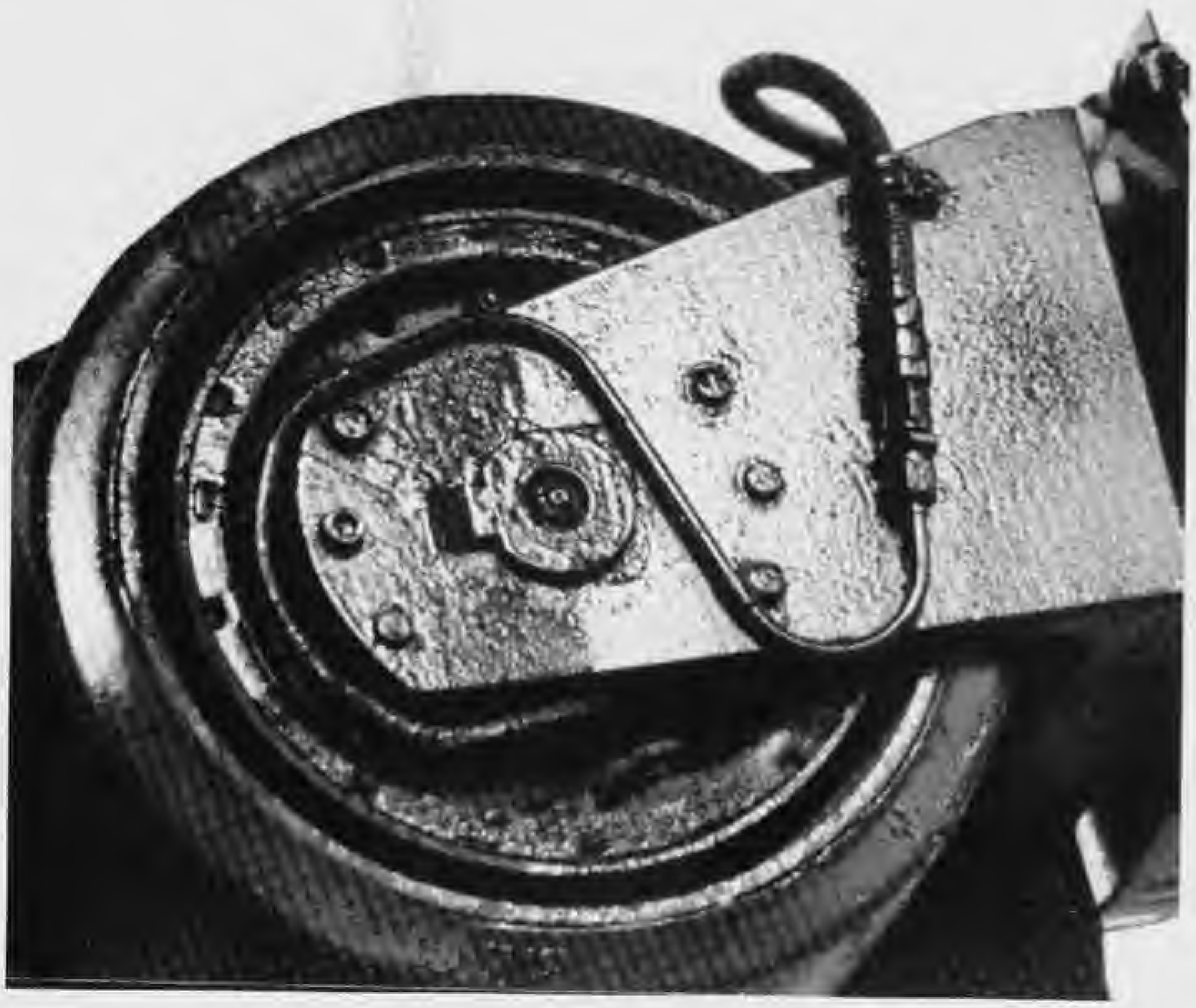
1. CIRCUIT BREAKER PANEL
2. LH AND RH BRAKE LEVERS
3. LEFT VOLT-AMP METER
4. RIGHT VOLT-AMP METER
5. CABIN PRESSURE ALTIMETER
6. CABIN TEMPERATURE RHEOSTAT
7. CABIN TEMPERATURE CONTROL SWITCH
8. RIGHT GENERATOR OUT WARNING LIGHT
9. A-C POWER OFF WARNING LIGHT
10. A-C POWER CONTROL SWITCH
11. WINDSHIELD DE-FOG SWITCH
12. CABIN AIR SUPPLY LEVER
13. COCKPIT LIGHTS SWITCH
14. UHF FREQUENCY SELECTOR (ARC-27A)
15. POSITION LIGHTS SWITCH
16. UHF SENSING SWITCH (ARC-27A)
17. VHF POWER SWITCH (ARN-14E)
18. VHF VOLUME CONTROL (ARN-14E)
19. RADIO COMPASS TUNING METER (ARN-6)
20. LEFT-RIGHT CONTROL SWITCH (ARN-6)
21. FREQUENCY BAND SELECTOR (ARN-6)
22. VOLUME CONTROL (ARN-6)
23. CW-VOICE SELECTOR SWITCH (ARN-6)
24. TUNING CRANK (ARN-6)
25. REMOTE COMPASS SYNC SINGNAL METER
26. SLAVED GYRO-FREE SWITCH
27. SET HEADING, FREE GYRO CONTROL
28. CABIN PRESSURIZATION AIR INLET
29. RADIO COMPASS FUNCTION SWITCH (ARN-6)
30. VHF FREQUENCY SELECTOR (ARN-14E)
31. UHF FUNCTION SWITCH (ARC-27A)
32. UHF VOLUME CONTROL (ARC-27A)
33. UHF CHANNEL SELECTOR (ARC-27A)
34. UHF CHANNEL SELECTOR LOCKING KNOB (ARC-27A)
35. BATTERY ONLY POSITION HOLDING CONTROL
36. D-C POWER CONTROL SWITCH
37. LEFT GENERATOR OUT WARNING LIGHT

YF2Y-1 135763 TWIN-SKI WHEEL DETAILS



Ten inch tail wheel and fairing on the lower rear hull of 135763. (Long)





Above, view of ski and wheel from directly behind the port ski. The small "skegs" installed to de-stabilize the aircraft's twin-skis can be seen in this view and in the one at the left. The tread of the main wheels with the skis fully extended was eleven feet ten inches. (B. J. Long)

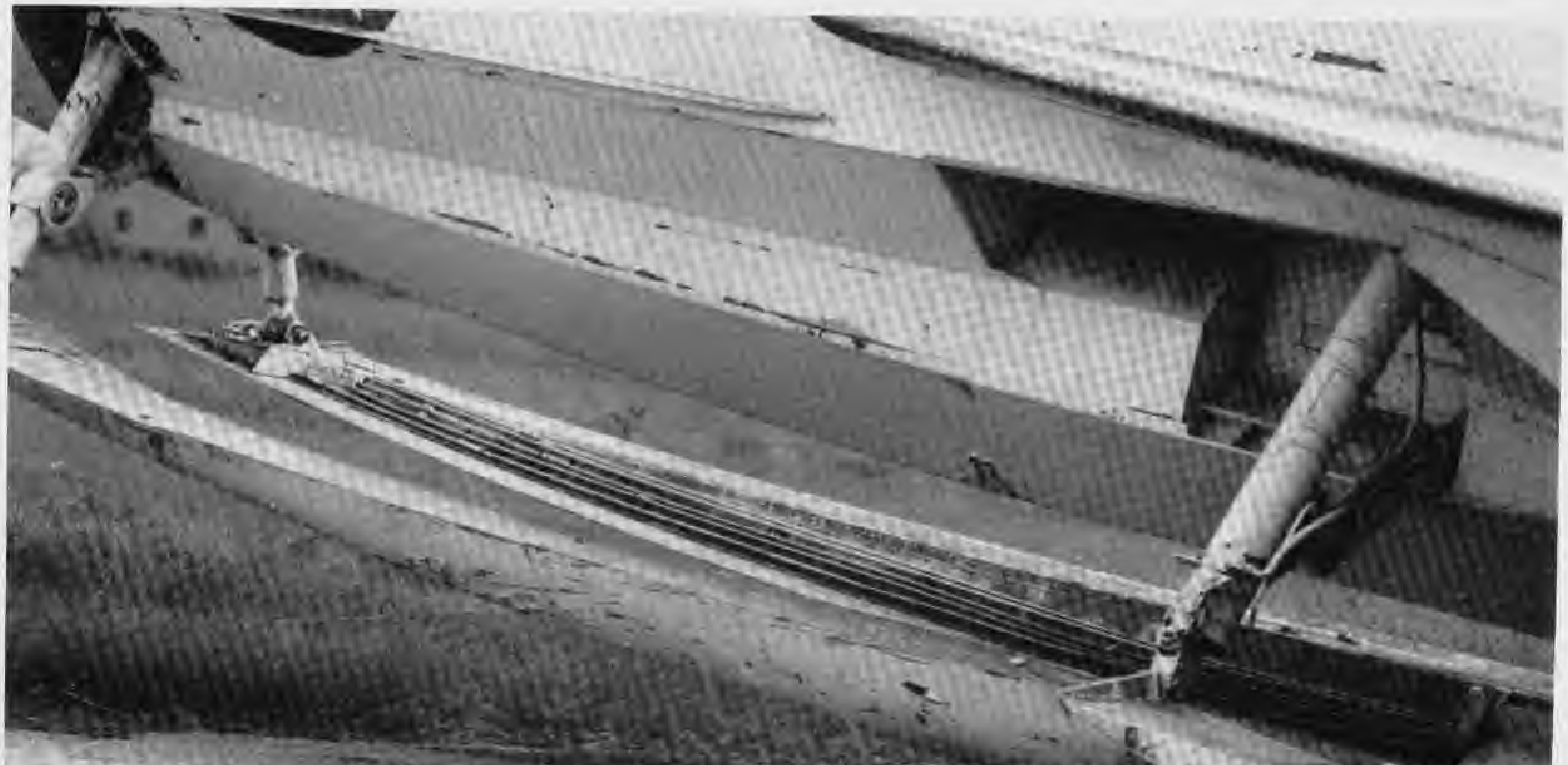
Detail photo at lower left shows the sixteen inch rubber ski mounted main wheels. (Ginter)

Below, view of the ski main wheel from the inside and below. (B. J. Long)

TWIN-SKI DETAILS FROM 135763 AND I35765

Above, distinctive footprint of the final twin-ski configuration from below as seen on 135763. (B. J. Long)

Above right, forward ski struts on 135765 minus the five flexible hydraulic lines which connected to the five metal lines shown in the bottom photo which ran on the inside of the skis to the main wheels. At right, rear ski struts and ski well retracting areas. Bottom, inside view of ski and of ski well. (Ron Downey)



OPERATIONAL SEADART CHARACTERISTICS BASED ON YF2Y-1 135763

TYPE: SEAPLANE INTERCEPTOR FIGHTER

GROSS WEIGHT (in pounds)			24373
USEFUL LOAD			7648
CREW (1)		200	
FUEL		6542	
Engine (1,000 gals, in tanks)	6500		
Trapped in system (6.5 gal.)	42		
OIL (engine 6.5 gal.)		49	
ARMAMENT (rockets, 44)		792	
EQUIPMENT		65	
oxygen	25		
gun camera	2.3		
miscellaneous	38		
WEIGHT EMPTY			16725
WING GROUP		3013	
TAIL GROUP		669	
BODY GROUP (hull)		2900	
SKIS AND MECHANISM		1757	
SURFACE CONTROL SYSTEM		492	
ENGINE SECTION		402	
PROPULSION		4765	
engines, with AB	4020		
engine accessories	363		
power plant controls	15		
starting system	83		
fuel system	284		
INSTRUMENTS		105	
HYDRAULIC AND PNEUMATIC		474	
ELECTRICAL		507	
ARMAMENT		429	
ELECTRONICS		708	
FURNISHING AND EQUIPMENT		504	

PERFORMANCE:

MAXIMUM SPEED AT 35,000 FT. (knots) 805 (M=1.4)
(with military power plus AB at take-off gross weight minus 40% fuel)

TAKE-OFF TIME IN CALM AIR (sec.) 35
(military power with AB at take-off gross weight)

LANDING SPEED AT 20° ANGLE OF ATTACK 113
(landing configuration at take-off gross weight minus 90% fuel)

AREAS:

WING AREA, INCLUDING ELEVONS		568 sq. ft.
elevon area	54.5	
VERTICAL TAIL AREA		80.7
rudder area	7.68	
SPEED BRAKE AREA		13
WATER RUDDER AREA		6.5

DIMENSIONS AND GENERAL DATA:

WING SPAN	35'4"
CHORD	
at root (centerline of airplane)	32'1"
at tip (station 173.7)	5'10"
mearn aerodynamic	21'4.9"
SECTION AND THICKNESS (percent chord): (sections are parallel to airplane centerline)	
at root	NACA0003.30-65 (Mod)
at tip (station 173.7)	NACA0004-65 (Mod)
average	3.83%
INCIDENCE (at root or tip)	0°
SWEEPBACK (of leading edge)	60°
DIHEDRAL (chord plane)	1°30'
ELEVONS:	
span (each at hinge line)	10'7"
chord (percent wing MAC)	
inboard (station41)	2'10.9"
outboard (station 173.7)	1'11.5"
TAIL: VERTICAL (section and thickness)	
root (W.L. 86)	NACA-0003.5-65 (Mod)
tip (W.L. 194)	NACA-0004-65 (Mod)
ASPECT RATIO	1.02
HEIGHT (3 point on beaching gear)	16'
LENGTH	51'1.5"
LENGTH FROM HOISTING SLING TO FARTHEST FORWARD PART OF NOSE	30'6"
CENTER OF GRAVITY (percent mac)	27.8%
ANGLE BETWEEN REFERENCE LINE AND WING ZERO LIFT LINE	0°
HULL: LENGTH	50'11.5"
BEAM (nominal)	5'5"
HEIGHT, DECK HORIZONTAL (MAX)	7'5"
DRAFT (perpendicular to load water line):	
skis up (from keel to hull)	40"
skis down (from lowest part of skis)	96.5"
ANGLE OF DECK TO REFERENCE LINE	0°
ANGLE OF NORMAL LOAD WATER LINE TO REFERENCE LINE	2°20"
ANGLE OF KEEL TO REFERENCE LINE	0°
ANGLE OF HEEL AT WHICH WING TOUCHES WATER	0°
HEIGHT OF CENTER OF GRAVITY ABOVE CENTER OF BUOYANCY (skis up)	25.1"
STATIC LOAD COEFFICIENT (based on hull)	2.38
DEADRISE ANGLE	35°
BEACHING GEAR:	
main wheel (diameter)	16"
tail wheel (diameter)	10"
tread of main wheels (fully extended)	11'10"

CONTROL SURFACE AND CONTROL MOVEMENTS. Control movements on each side of neutral position for full movement as limited by stops are estimated to be as follows:

RUDDER: 25 degrees right, 25 degrees left
RUDDER PEDALS: 3.25 inches forward, 3.25 inches aft
ELEVONS: 35 degrees up, 25 degrees down
elevon as elevator (landing gear up): 32 degrees up, 22 degrees down
elevon as elevator (landing gear down): 40 degrees up, 30 degrees down
elevator control: 8.52 inches aft, 5.22 inches forward
elevon as aileron (landing gear up): 7 degrees up, 7 degrees down
elevon as aileron (landing gear down): 15 degrees up, 15 degrees down
aileron control: 7 inches right, 7 inches left
WATER RUDDER: 30 degrees right, 30 degrees left
SPEED BRAKES: 60 degrees each side

DATA FROM CONVAIR REPORT SD-488-1

The end of World War Two resulted in a sudden and drastic impact on America's aircraft industry. Many companies did not survive as the jet age had arrived and competition was intense to obtain U. S. Army Air Corps (later USAF) and Navy contracts for development and production of new aircraft designs. The Korean conflict and the Cold War with the Soviet Union acted as a potent catalyst to hasten the new era and prolong intense military requirements for advanced designs and large inventories of new high performance aircraft.

Surviving companies had to be very adaptive to rapidly changing business climates. Flight test groups within companies were organized and located to fit development, test, and production requirements including facilities and personnel. Normal were test operations at Edwards Air Force Base and many other military bases throughout the country. Flight test personnel had to be flexible and mobile to meet these demands.

By this time most industry test pilots were ex-military with experience from World War Two and Korea. However, a number of famous "old timers" from earlier days were still leading test pilots. Military Reserve and National Guard flying was a bonanza for many contractor test pilots in being able to maintain proficiency in a wide variety of World War Two and post war aircraft in addition to flying their new and experimental types as contractor test pilots. During my years on the SeaDart and F-102A programs, I flew in a Naval Reserve jet fighter squadron at NAS Los Alamitos, California, along with Don Germeraad and Charlie Richbourg. At Los Alamitos I regularly flew five different types of aircraft. In one twelve month period in 1956 I flew nineteen different types of military aircraft. Flying so many types in short time spans also honed our skills as test pilots besides the pleasure of experiencing the flying qualities of each aircraft. The days of being current in so many types are long gone.

By 1955 Convair San Diego had five test groups: Engineering at San Diego for Navy and Commercial (Convairliners and military versions); Engineering at Edwards AFB for the F-102A; Engineering at Holloman AFB, New Mexico for F-102A Weapon Systems; Production at San Diego for Convairliners; and Production at Palmdale, California for the F-102A program. I was privileged to fly with all groups except F-102A production test at Palmdale.

Particularly gratifying to me was flying with L. V. "Lou" Hoffman, Project Engineering Test Pilot for the piston engine Convairliners. I flew co-pilot for Lou on the Convair 340 speed improvement program and 440 FAA certification. Lou had a FAA Designee Test Pilot rating. I learned much from Lou about big multi-engine testing and often I flew left seat, Lou was generous and I was pleased. On some of the tests such as accelerate-stop take-off demonstrations, design dive limit speed, and emergency cabin pressure loss, we experienced some interesting moments.

In telling this SeaDart story and my personal involvement as a test pilot, it is certainly not my intent to compare my few years as a Navy or professional test pilot with other test pilots of the past, present, or future. I have the greatest respect for all those other test pilots, their skills, experience, and hazardous events. I have had the privilege of knowing or meeting so many of them. I am grateful that I had the opportunity to fly during those abundant aircraft years and test the most unique seaplane in aviation history.

The SeaDart story would be incomplete without recognizing a few of the Convair San Diego personnel who played roles in SeaDart design, development, and test operations. There were hundreds of Convair employees who contributed materially to the program and they should all feel proud of their individual and collective roles. The following list mentions only a few:

SEADART TEST PILOTS

*E. D. "Sam" Shannon, Chief of Engineering Flight Test.

*Charles E. Richbourg, Project Engineering Test Pilot.

*Billy Jack Long, Project Engineering Test Pilot.

*Donald P. "Don" Germeraad, Chief Engineering Test Pilot, Navy and Commercial.

SEADART CHASE PILOTS

*L. V. "Lou" Hoffman, Project Engineering Test Pilot, Convair 340 and 440.

*James F. "Skeets" Coleman, Project engineering Test Pilot, XFY-1 "POGO".

MANAGEMENT AND SEADART PROGRAM PARTICIPANTS

*B. F. "Sandy" Coggan, Convair San Diego General Manager.

*Joseph "Joe" Famme, Assistant Chief Engineer.

*Ernest G. "Ernie" Stout, Director Navy R&D and sales.

*Herb Sharp, SeaDart Project Engineer.

*Dwight H. Bennett, Assistant Project Engineer.

*Donald Worden, Assistant Project Engineer.

*Ted Sanford, Senior Flight Test Engineer.

*E. E. "Gene" Wigham, Flight Test Engineer.

*William F. "Bill" Chana, Flight Test Instrumentation Engineer.

*Harvey Ingalls, Flight Test Instrumentation Engineer.

*Tom Fleck, Flight Test Data Analyst.

*Al Sharp, General Foreman Ramp Operations.

*Jack Fogleman, Flight Test Engineer Ramp Operations.

*Hugh Brooks, Group Engineer Hydrodynamics.

*Frank Thornberg, Hydrodynamics Engineer.

*Garner Green, Chief of Structures.

*A. L. "Art" Williams, Senior Structural Dynamics Engineer.

*Michael Dublin, Chief of Structural Dynamics.

*James Wainwright, Chief of Wing Design.

*John Bergstrom, Chief of Fuselage Design.

*Len Cederwall, Chief of Powerplant Design.

*Paul Ferarra, Chief of Electrical Design.

SEADART NUMBER ONE, XF2Y-1 BuNo 137634 (SMALL RIGID SKI)

The Navy's Bureau of Aeronautics in late 1956 decided to test a small rigidly mounted hydro-ski on the XF2Y-1 aircraft. This new configuration had a hydrofoil shape in addition to having planing ski capabilities. The rigid mounting and placement made actual takeoff impossible because of the 17 to 19 degree nose-high attitude required for lift-off.

The aircraft was taken out of storage and the entire large single-ski oleo system was removed from the aircraft. The rigid ski installation required a new structural arrangement for attachment to the aircraft hull and airframe. The configuration change required several months in Convair's experimental shop.

On 21 March 1957, I made the first of three test operations with the last test (FTO-248) eighteen days later, being fifty-five minutes in duration. Since this ski had no integral wheels, the auxiliary beaching gear was required for all ground handling including water ingress and egress. Every taxi run was aborted between fifty and sixty knots because of violent pounding impacts in the cockpit. The impacts were not vibratory in nature. My qualitative evaluation of this rigid ski being totally unacceptable was verified by test data.

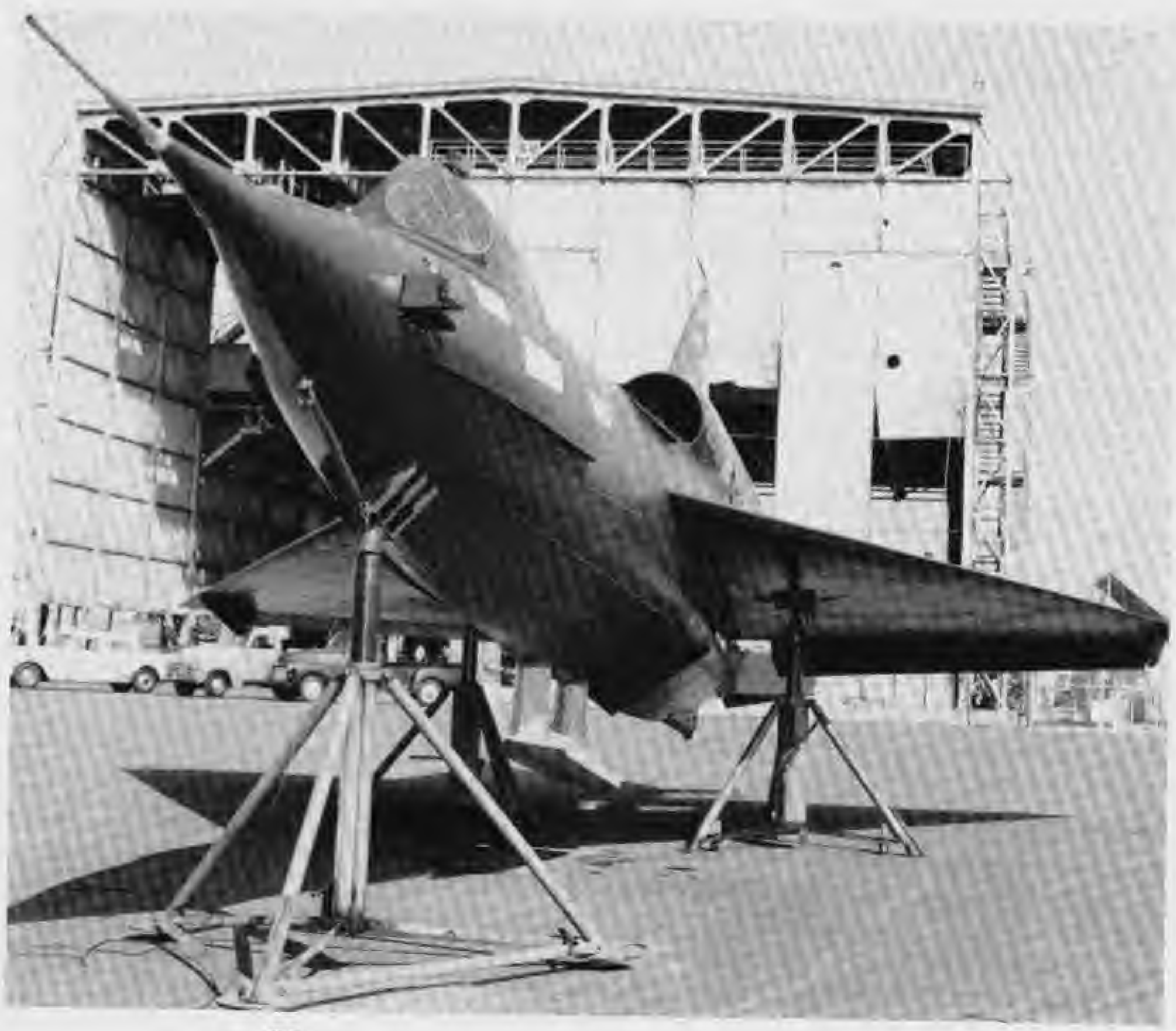
The Bureau of Aeronautics then desired an additional small rigid ski configuration tested. It was about half the size of the first rigid ski and of the same planing hydrofoil design. The old reliable XF2Y-1 was returned to the experimental shop for this last modification which again took several months.

In the fall of 1957 the XF2Y-1 SeaDart was tested for the last time. This new and smallest of all ski configurations was evaluated by Convair San Diego Chief Engineering Test Pilot for Navy and Commercial Aircraft, Donald "Don" P. Germeraad. Don was an experienced flying boat pilot, test pilot, Captain USNR, and "Fellow" in the Society of Experimental Test Pilots. His tests proved the same as mine on the previous rigid ski; ie, completely unacceptable for the same reasons.

The XF2Y-1 SeaDart was placed in storage, never to be tested again. A total of 250 Flight Test Operations (FTO) had been conducted on this aircraft since Sam Shannon made FTO-1 in December 1952, almost five years earlier.

Final smallest rigid ski and test pilot, Don Germeraad, in the fall of 1957.

The XF2Y-1 in its final configuration with the smallest rigid ski attached. Note redesigned spray rail and camera boxes fitted to the forward fuselage. The water rudder is also open. (via Hal Andrews)



Top, side view of 137634 on the Convair ramp with the smallest rigid ski fitted. (via Hal Andrews) Above, after final retirement the XF2Y-1 was shipped to Pax River and covered with preservative and stored. At left, the XF2Y-1 in storage shed at NASM Silver Hill facility. (Jim Burridge) Lower left, close up of the front of the ski as seen today. (Jim Burridge) Below, close up of the rear ski support without it's faring and of the cable bracing system. (Jim Burridge)

THE YF2Y-1 AIRCRAFT IN RETIREMENT AND ON DISPLAY

Above, 135763 at NAS North Island in 1959. (Clay Jansson)
At right, 135763 as seen during restoration. (B. J. Long)
Below, 135763 as seen today in it's place of honor in front of the San Diego Aerospace Museum at Balboa Park. (B. J. Long)

Above, SeaDart number four, 135764, in june 1957 was transferred to the east coast on the deck the USS Essex along with a F3D SkyKnight and a deck full of F9F Panthers. The SeaDart had "HOLD FOR NATIONAL AIR MUSEUM" painted on the preservative, but 135764 ended up at NAS Willow Grove. (National Archives) Below, time and weather had severly damaged the aircraft by 1966. (Robert Esposito) At right, in September 1992, after two years of restoration by volunteers called "RESTORATS" Delaware Valley Historical Aircraft Association (DVHAA) the aircraft was once again finished in its original markings and dedicated by B. J. Long. (Alan Fisk)

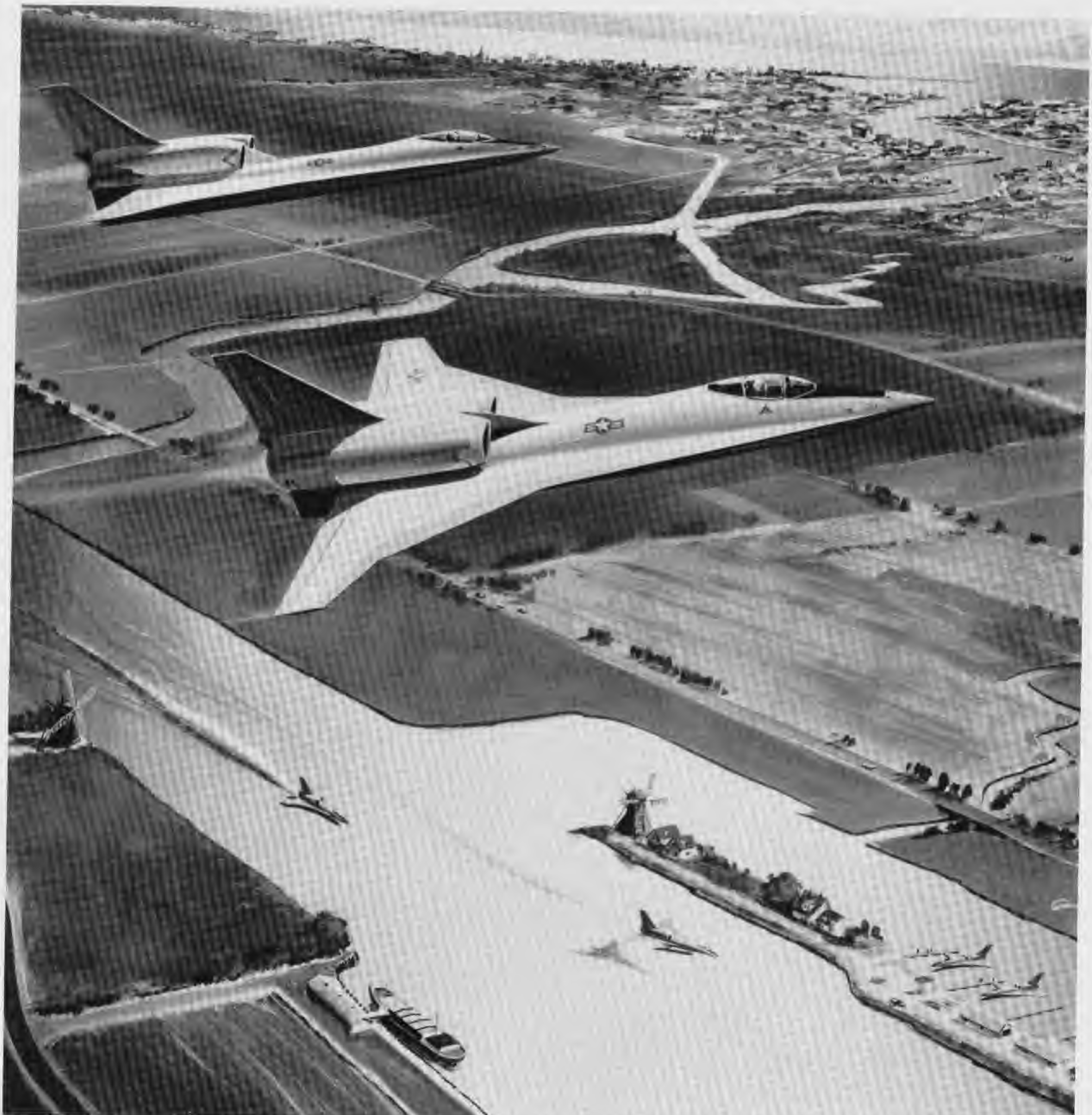
Above and below, SeaDart number five (135765) in 1959 at NAS North Island, California. The aircraft was not painted in the standard gloss blue Navy color scheme, but rather in a flat sea blue scheme with white interiors for the ski wells, extension mechanism and interior of the skis. The nose probe was painted with red and white circles and the intake area was red bordered by white. Engines were not installed in this aircraft. (Clay Jansson)

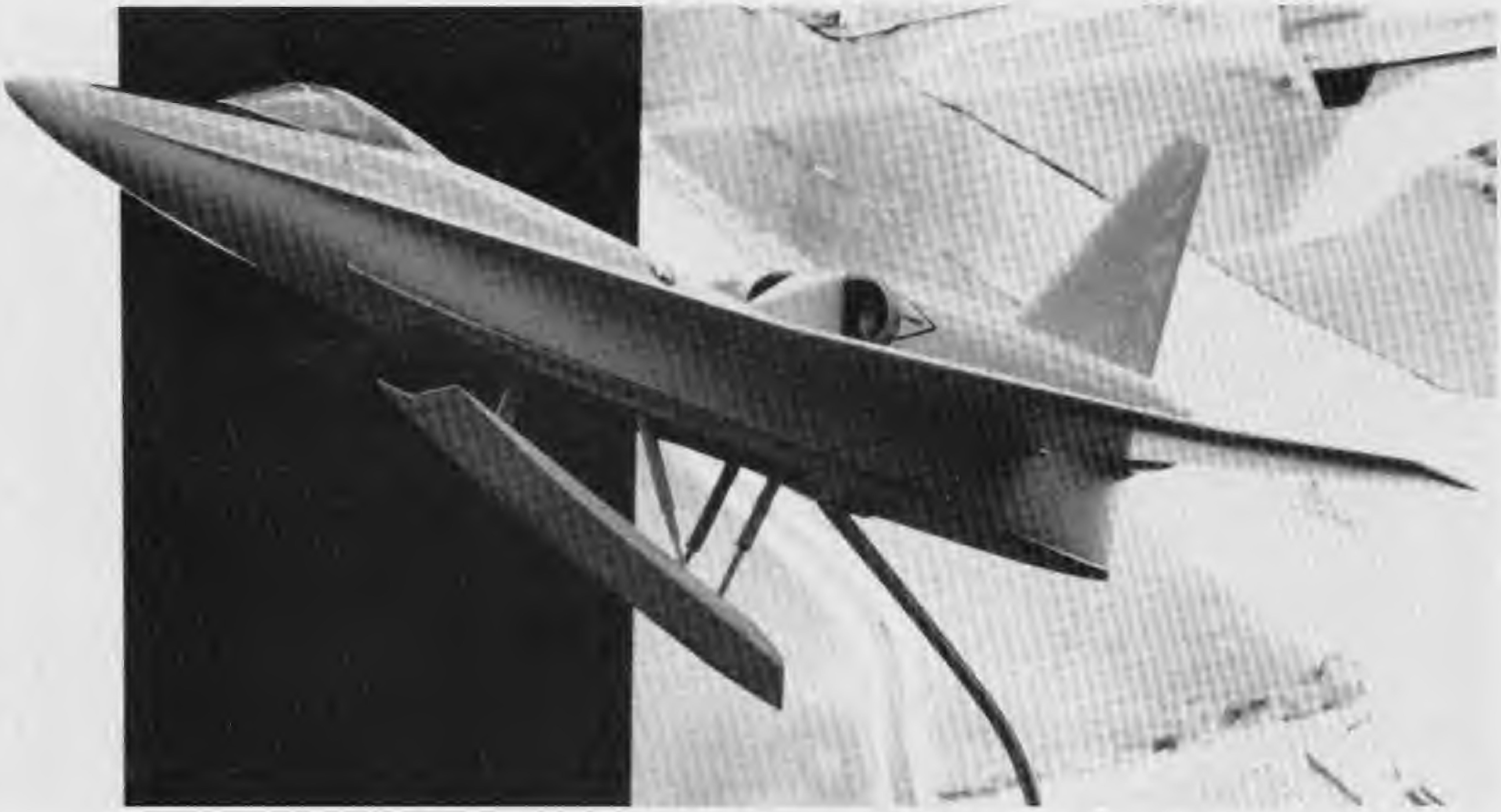
Above, 135765 was loaded onto the USS Sargent Jack L. Pendelton on 1-23-63, presumably to be transported to the East Coast and its future home at the SST Aviation Museum in Kissimmee, Florida. (National Archives) Below, 135765 as seen on display in Florida in 1982. The aircraft was overall white with red nose probe, intake lips, wing leading edges and tail flash. The SST Museum went bust and in 1985 a scrap dealer in Tennessee appropriated the aircraft which was saved from extinction by Leonard McGinty where it was referbished at the Sun 'n Fun site on the Lakeland, Florida Airport.

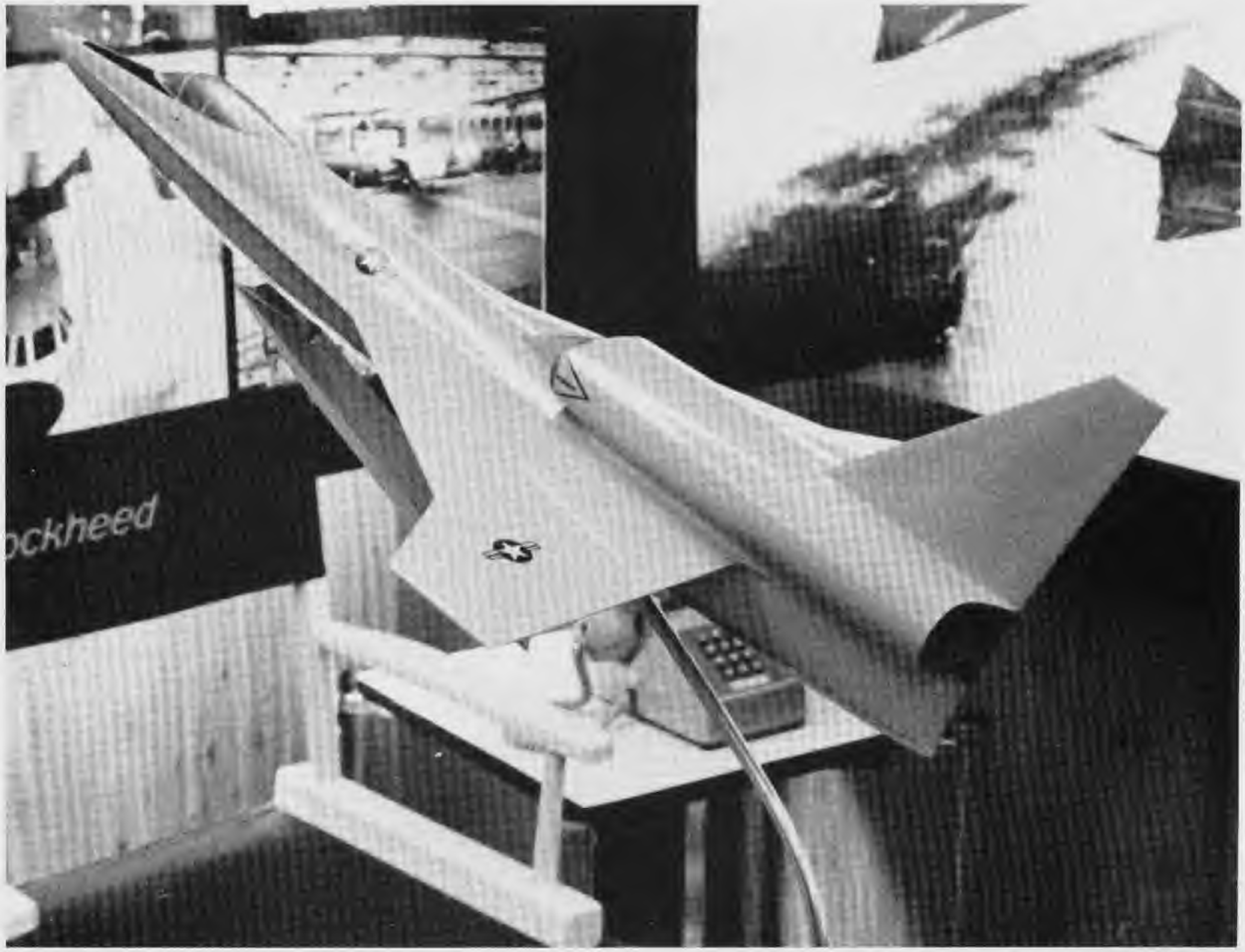
LOCKHEED PROPOSAL FOR A MACH TWO "SEADART" TYPE FIGHTER

Over twenty years after the SeaDart program ended, Lockheed Aircraft Company in Burbank, California, made design studies for a Mach Two water based fighter with the exact large single ski configuration tested on the XF2Y-1 SeaDart. Their aircraft design had a modified deltawing with twin afterburning engines mounted above the wings. Lockheed's ski designer, Frank Thornberg, had also designed the large single-ski for the Convair SeaDart. Lockheed made proposals for their aircraft to NATO nations for basing in Europe's many lakes, rivers and sheltered water areas.

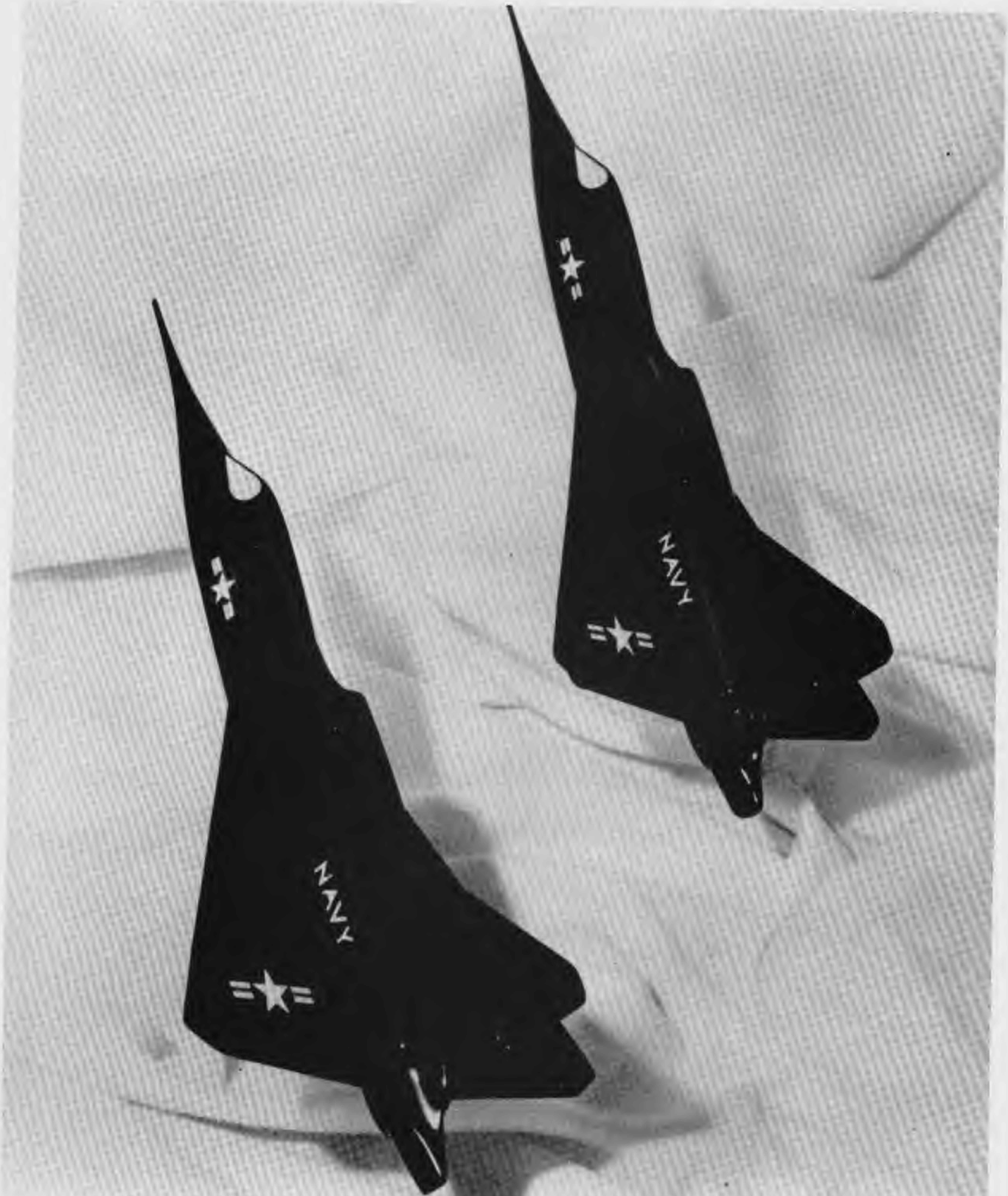
Below, artist conception of the proposed fighters operating from the river and canal areas in Holland. At right, two photos of the large model made by Lockheed to promote the concept to the industry and prospective buyers. The wing blends into the forward fuselage in much the same way as the wing on the F/A-18 Hornet. In the top photo the location and size of the spray rails are evident. (Lockheed)






ockheed

Below, Convair proposal models of the XF2Y-1 SeaDart program. (National Archives)



MANUFACTURERS MODELS

Above, manufacturers one tenth scale solid mahogany wind tunnel model of the original XF2Y-1 on display at the Naval Air Test Center, Patuxent River, Maryland (NATC Museum) in July 1986. (Ginter)

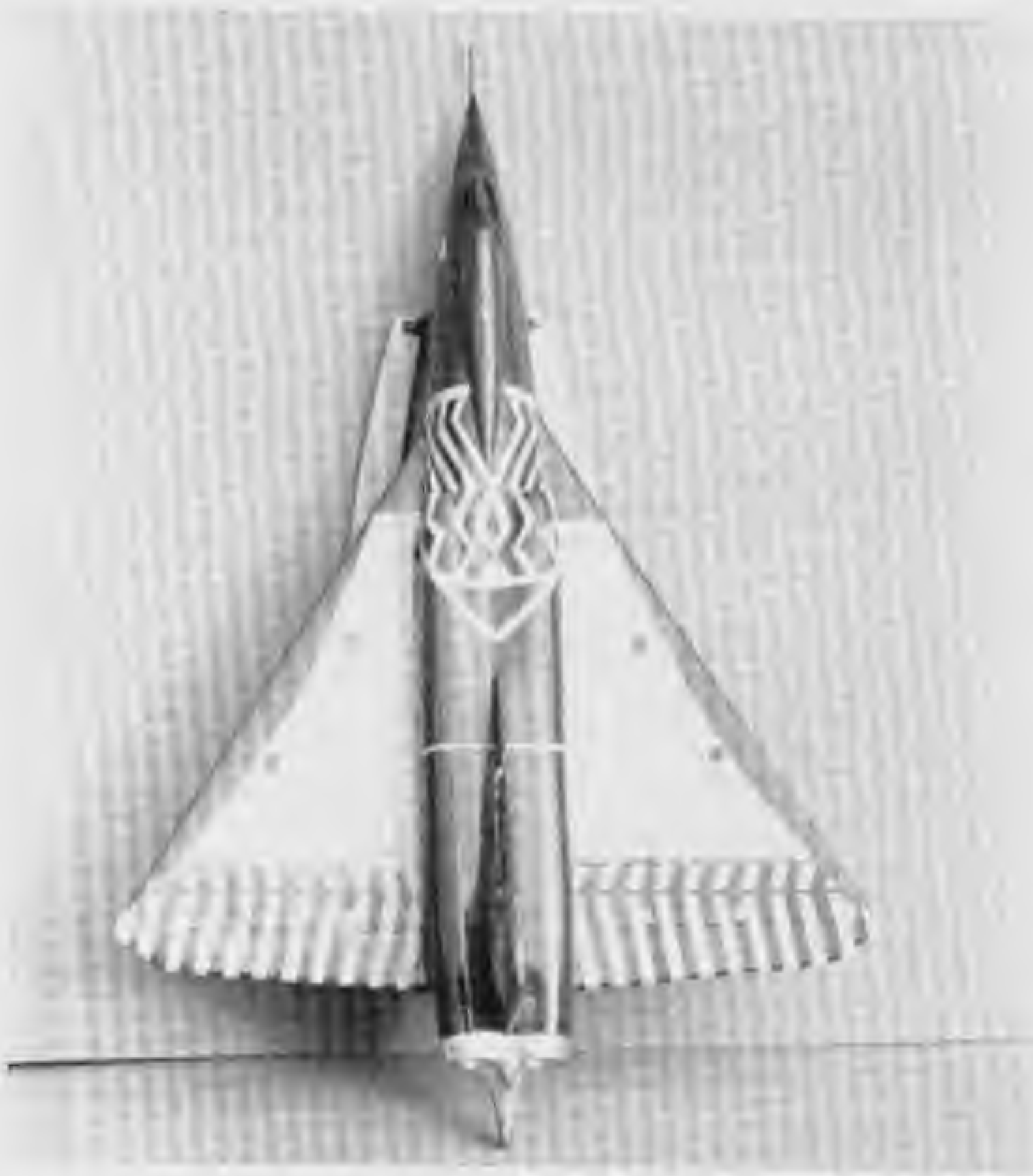
At right, manufacturers desk display model of the YF2Y-1 on display at the San Diego Aerospace Museum in 1990 with other Convair desk models including the XF-92, F-102 "Delta Dagger", F-106 "Delta Dart" and XFY-1 "Pogo". (Ginter)

PLASTIC SEADARTS, RARE-PLANE DETECTIVE KIT #RPD01 (STROMBECKER)

BY STEVE GINTER

Having built both this kit and the Mach Two kit for this book, I found the 1/60th Rare Plane Detective kit the most satisfying. Once finished it most accurately matches the SeaDarts profile. The kit is early 1950 vintage and has no cockpit details. To make a really good model you would have to scrap the skis and build new ones from scratch. The kit is marketed as a XF2Y-1, but is really a YF2Y-1 as the "X" model did not have the J46 engines while equipped with twin-skis. A good decal sheet was provided with all the yellow tracking stripes as used the first two SeaDarts. The kit was a welcome addition to my collection.


NAVY




NAVY


NAVY

MACH 2 1/72 SCALE YF2Y-1 SEADART

BY TOMMY THOMASON

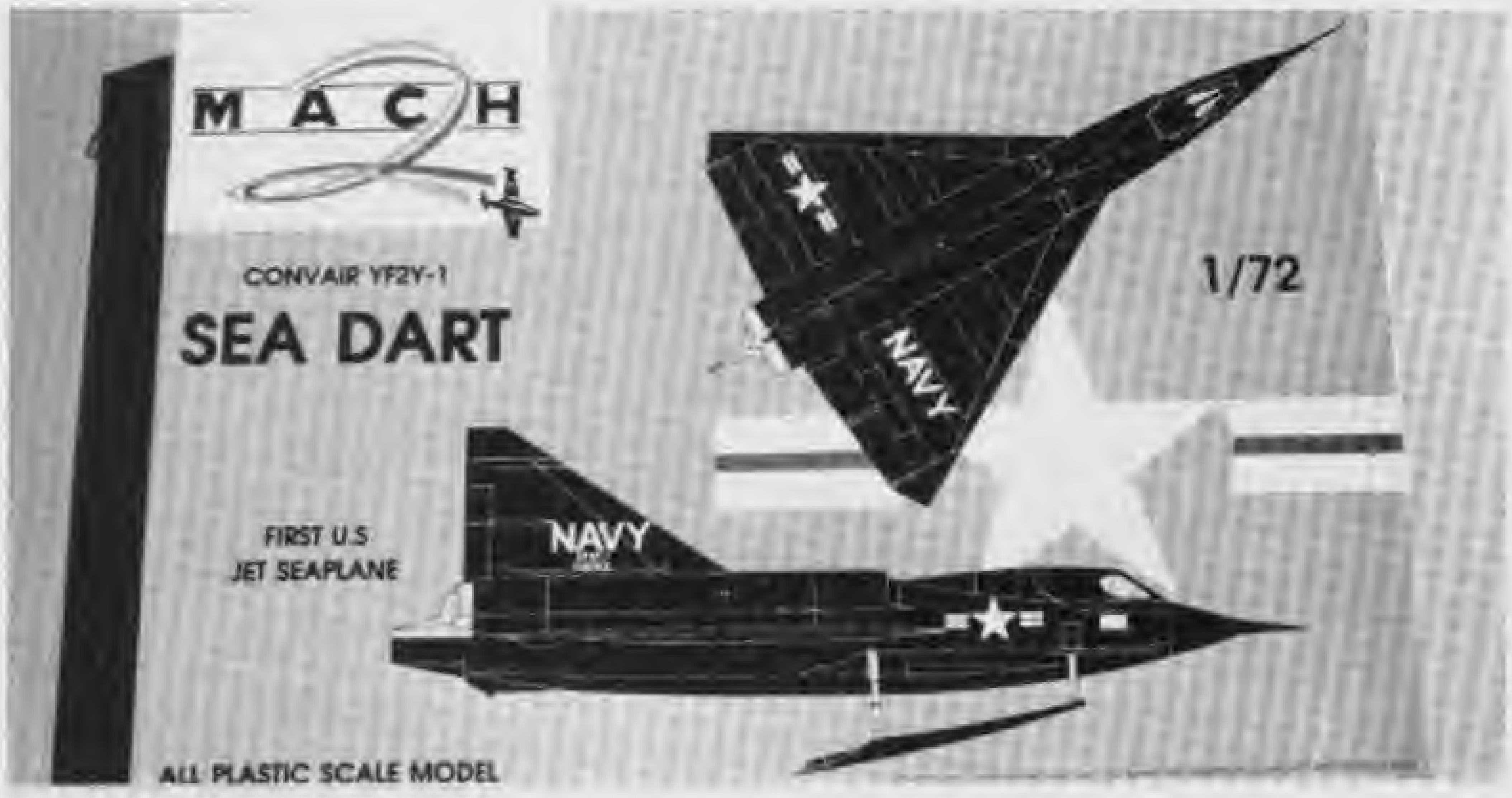
In 1992, Mach 2, a French company, produced a 1/72 scale injection molded kit of the SeaDart. Although somewhat crude compared to a state of the art kit, it features engraved panel lines and is complete in all details. A model out of the box represents BuNo 135763 with the "retractable" ski wheel. I didn't bother with the milky decals, which in any event didn't include the BuNo or model designation which are the only unique markings on this aircraft.

Some fitting and filing will reduce the amount of filling required. The kit instructions recommended removing the vertical fin for a better fit of the nacelles. I left the vertical fin on the left fuselage half but removed the vertical fin insert from the right hand fuselage half to eliminate one fit problem. I also added tailpipes and reshaped the boat-tail between the tailpipes for a more realistic appearance.

The instrument panel, control stick, and ejection seat can be added after fuselage assembly. The ejection seat must be located about half way forward in the cockpit tub rather than at the rear end to be correctly positioned. The canopy windows were a little small and not flat panes as they should be, so I reshaped and repolished the window areas.

The upper piece of the right wing was warped which I corrected by heating (in water almost too hot to stand) and twisting the wing back to shape, and then gluing and clamping the lower surface on. I also had to cut along a panel line and bend the wing tip down.

The kit instructions show the ski wheel positioned on the outboard side of the ski when it is "down", which is incorrect; the bottom of that portion of the ski should face outboard when the wheel is rotated into the beaching position.



Photos:

This page, Mach 2 kit built and photographed by Steve Ginter.

Next page, Mach 2 kit built by Tommy Thomason and photographed by Jay Miller, Aerofax Inc.


NAVY

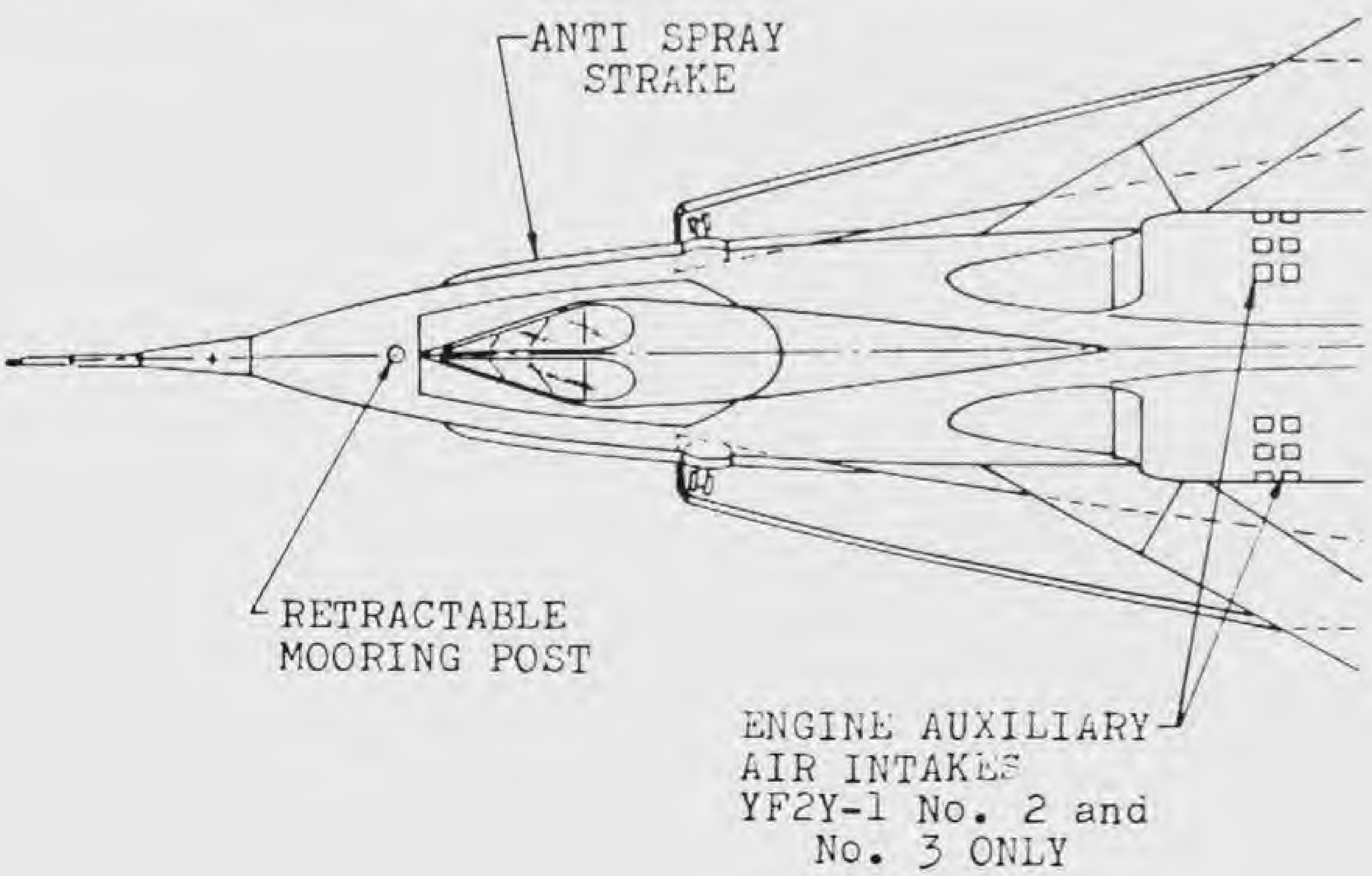

NAVY
NAVY


NAVY
NAVY

THE SEADART IN PLASTIC (VACUFORM)

airmodel 1:72 KIT 183

Above, in the 1970s Airmodel produced a vacuform kit number 183, which was marketed as the XF2Y-1. The kit consisted of six parts plus the canopy. The kits shape only provides for an approximation of the SeaDart. Below, Mike Herrill of Execuform produces a fairly accurate vacuform kit of the SeaDart, which comes with two sheets of 72nd scale drawings for the first three airframes.



Convair
SEADART
YF2Y-1

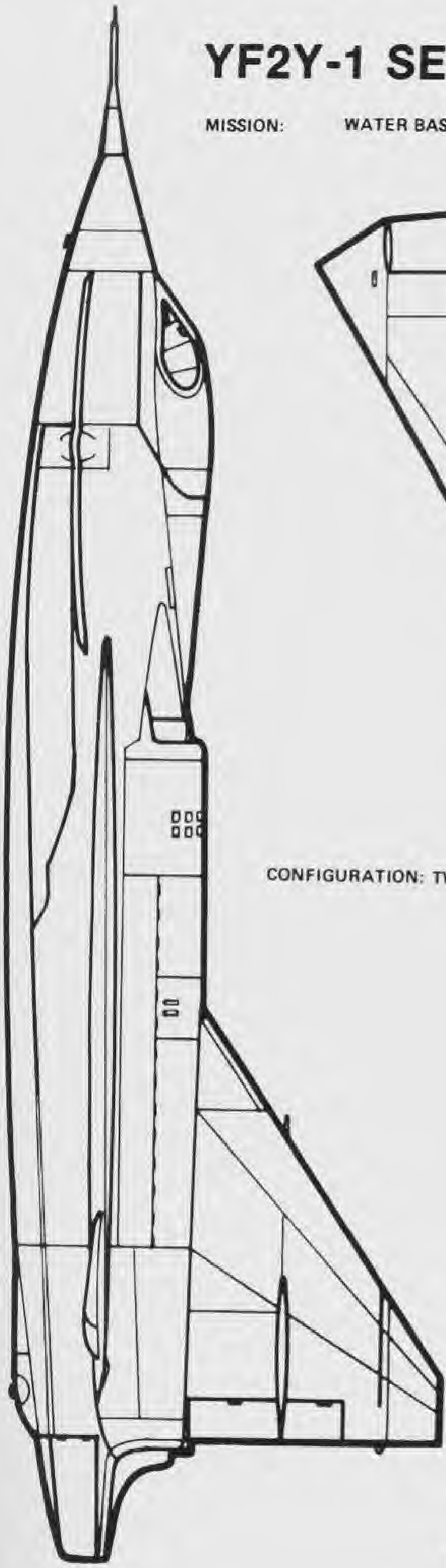
NOSTALGIA 1/72 ON WINGS

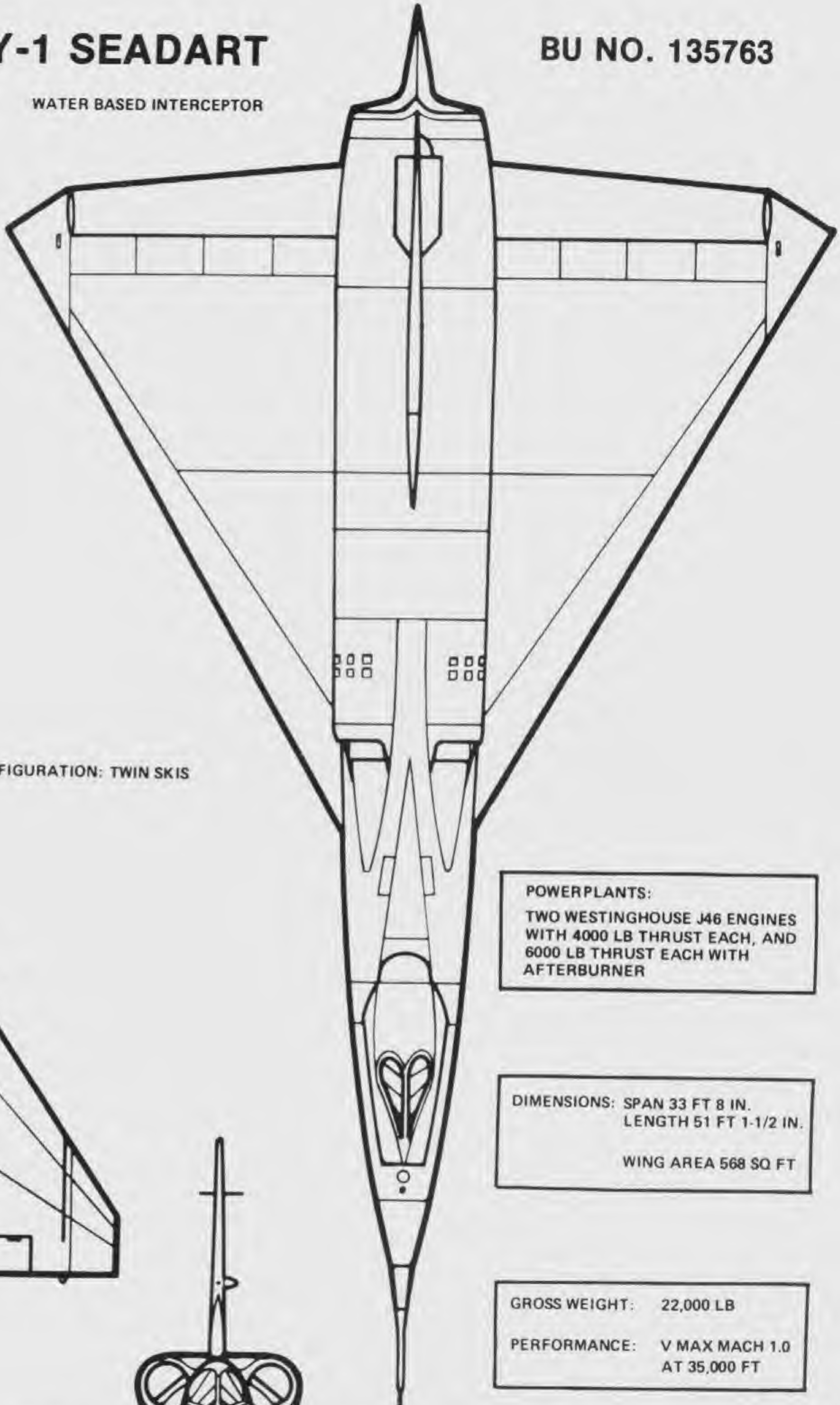
From EXECUFORM
P. O. BOX 7853
Laguna Niguel, CA
92677

YF2Y-1 SEADART

BU NO. 135763

MISSION: WATER BASED INTERCEPTOR





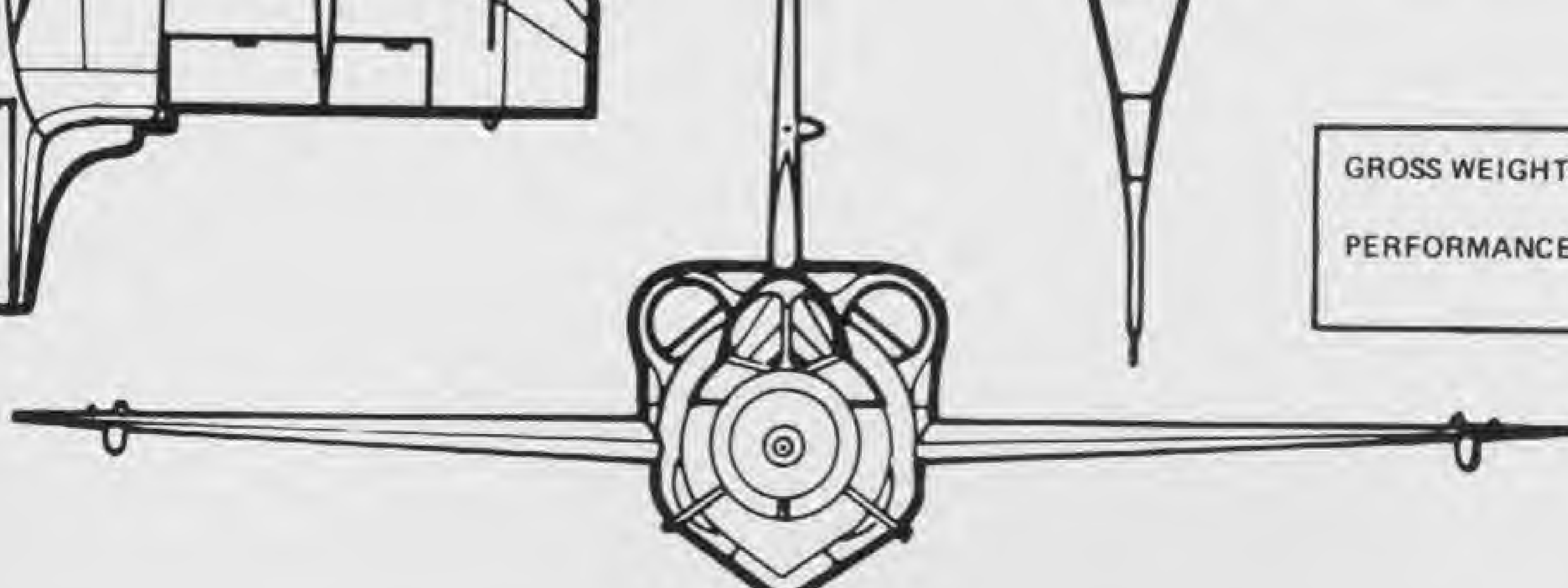
CONFIGURATION: TWIN SKIS

POWERPLANTS:

TWO WESTINGHOUSE J46 ENGINES WITH 4000 LB THRUST EACH, AND 6000 LB THRUST EACH WITH AFTERBURNER

DIMENSIONS: SPAN 33 FT 8 IN.
LENGTH 51 FT 1-1/2 IN.

WING AREA 568 SQ FT



GROSS WEIGHT: 22,000 LB

PERFORMANCE: V MAX MACH 1.0 AT 35,000 FT

Graphics By
Stan Jones


NAVY


NAVY
137634


NAVY